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ABSTRACT

In 1972 American universities will confer 33,700 doctorates. An essential feature of the process which leads to the doctorate is the submission and defense of a dissertation. The doctoral dissertation must embody the results of extended research, be an original contribution to knowledge and include material worthy of publication. It is surprising, therefore, that "Dissertation Abstracts," the primary source of abstracts of dissertations is usually overlooked in reports of English-language abstracting and indexing services. This study provides empirical data about the dissertation as an information source. It assesses diffusion and assimilation patterns of dissertation contents. The assessment was based upon an analysis of patterns of (1) diffusion of dissertation contents in the open literature of botany, chemical engineering, chemistry and psychology and (2) assimilation of dissertation contents from the original format as reflected by citations to the dissertation itself. It includes a literature review, a description of research design and methodology, an analysis of collected data noting similarities and dissimilarities, and a presentation of conclusions and implications drawn from the investigation. The chapters are supplemented by data presented in the Appendix. (Author/NH)

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THE PH.D. DISSERTATION: AN ANALYSIS OF THE DOCTORAL DISSERTATION AS AN INFORMATION SOURCE

by

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DISSERTATION

Presented to the Faculty of the Graduate School of

The University of Texas at Austin

in Partial Fulfillment

of the Requirements

for the Degree of

DOCTOR OF PHILOSOPHY

LI 003 778

THE UNIVERSITY OF TEXAS AT AUSTIN

August, 1972

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C. J. B.

The University of Texas at Austin

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CHAPTER I

INTRODUCTION

In 1972 American universities will confer 33,700 doctorates.[1] Excluded from this recent projection by the National Science Foundation are first professional degrees at the doctoral level, e.g., M.D., D.D.S., and J.D.

In the process that leads to conferring of the doctorate (Ph.D. or D.Ed., for example) an essential feature is the submission and defense of a dissertation. The dissertation,

> a substantial paper that is submitted to the faculty of a university by a candidate for an advanced degree that is typically based on independent research and that if acceptable usu. gives evidence of a candidate's mastery both of his own subject and of the scholarly method,[2]

is the capstone of a long and intensive period of academic training.

University graduate catalogs and bulletins underline the importance of the dissertation. While the precise description may vary from institution to institution, the essence of most is typified by the following statement.

> The doctoral dissertation must embody the results of extended research, be an original contribution to knowledge and include

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[1] 1969 and 1980, Science & Engineering Doctorate Supply & Utilization, NSF 71-20 (Washington, D.C.: National Science Foundation, 1971), p. 26.

[2] Webster's Third New International Dictionary of the English Language, Unabridged (Springfield, Mass.: G. & C. Merriam & Co., 1961) p. 656.

> material worthy of publication. It should demonstrate the candidate's ability to conduct an independent investigation, to abstract principles upon which predictions can be made, and to interpret in a logical manner facts and phenomena revealed by the research.[3]

The proliferation of doctorates in this country has been the topic of numerous investigations and reports. Data concerning the proliferation include historical developments as well as projections into the coming decades.

> From 1861, when Yale became the first American university to grant the Ph.D., through 1970, American universities awarded 340,000 doctor's degrees. Half of these were awarded in the last nine years of the period. If the current projections of degree trends are borne out, another 340,000 (and probably more) will be awarded in the 1971-80 decade.[4]

This country's investment in production of doctorates draws capital from all sectors of the nation's economy--national, state, local, public and private. The magnitude of the financial investment is underscored by Glenny's observation:

> A recent estimate by the National Science Foundation placed total graduate education costs for the nation in 1970 in excess of undergraduate expenditures. Yet the ratio of undergraduate to graduate enrollment is 10-1.[5]

Various estimates of the cost of producing a doctorate have been offered. For operations alone, from $3,000 to $10,000 annually are required for each doctoral student enrolled. One extrapolation suggests that the

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[3]Mellon Institute of Science and Carnegie Institute of Technology, Graduate Studies, 1970-1972 (Pittsburgh: Carnegie-Mellon University, 1970), p. 13.

[4]Dael Wolfle and Charles V. Kidd, "The Future Market for Ph.D.'s," Science, CLXXIII (August, 1971), 784.

[5]Lyman Glenny, "Doctoral Planning for the 1970's," Research Reporter, VI, No. 1 (1971), 2.

average cost of a science doctorate is $62,000.[6] (The figure includes an attrition factor.)

The investment in time is equally great. During the period 1964-66, statistics for all fields indicate that 8.2 years (median) were required from baccalaureate to doctorate with 5.4 years registered time, i.e., time during which the student was enrolled either on a full- or part-time basis.[7]

Collectively the national investment in money and time in the production of doctorates is well documented. As the first visible product of an arduous academic training process to produce ". . . candidates who have demonstrated substantial scholarship, high attainment in a particular field of knowledge, and ability to do independent investigation and present the results of such research,"[8] the dissertation incorporates the results of research undertaken during the process of attaining a doctorate.

As a vehicle to transmit the results of research, the dissertation becomes an integral part of the research process. The importance of this role was articulated by the Committee on Scientific and Technical Communication of the National Academy of Sciences--National Academy of Engineering: "A fundamental article of faith in scientific and technical communication is that research is not complete until results are made

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[6]Ibid.

[7]Yearbook of Higher Education, 1969 (Los Angeles: Academic Media, 1969), p. 531.

[8]Bulletin, Courses and Degrees, 1971/72 (Stanford, Calif.: Stanford University, 1971), p. 10.

available."[9] The applicability of the observation extends beyond scientific and technical research to include all research endeavors.

The goal of doctoral education is clearly stated in the extract from the Bulletin of Stanford University cited above, a statement often found in similar terms in catalogs and bulletins of American universities. Likewise, the role of the dissertation is clearly defined by statements in university catalogs as a vehicle for the results of research undertaken during the doctoral program.

In spite of the clearly articulated goals of doctoral education and stated role of the dissertation, incongruities occur in the information/communications arena. Consider the following two examples involving the dissertation.

As a primary source of abstracts of dissertations accepted by American universities, Dissertation Abstracts[10] chronicles the recent growth in the number of dissertations produced annually in this country. It is surprising, therefore, to note that the SATCOM Report cited above does not mention dissertations or include Dissertation Abstracts in a discussion of nineteen major, nongovernmental, English-language abstracting and indexing services.

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[9]Committee on Scientific and Technical Communication. National Academy of Sciences--National Academy of Engineering, Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution (Washington, D.C.: National Academy of Sciences, 1969), p. 86. (Hereinafter cited as the SATCOM Report)

[10]The increased coverage of Dissertation Abstracts to include dissertations produced in other nations of the world is indicated by the recent change in title to Dissertation Abstracts International. Dissertation Abstracts was produced through the cooperative efforts of the Association of Research Libraries and University Microfilms to provide a comprehensive index to recently accepted dissertations.

If research is incomplete until the results are made available as the SATCOM Report suggests, then the omission (unintentional or otherwise) of the primary source of information about the current output of this nation's dissertations is, indeed, incongruous with a complete, systematic diffusion process of the results of doctoral research.

The role of Dissertation Abstracts is questioned in the statement by Norman Stevens, Associate University Librarian, University of Connecticut, in a recent book review, ". . . it [a book being reviewed] might better, like most doctoral dissertations, have been left to the decent obscurity of Dissertation Abstracts and University Microfilms. . ."[11]

The implications of the omission in the SATCOM Report and the observation by Stevens are certainly open to question and to interpretation; yet, neither is the first instance in the very recent past in which the dissertation as a form of literature seems to have been slighted. For example, in 1967, a 3,698-item bibliography on "communication of scientific and technical literature" was published by Rutgers University Press. Items in the bibliography were taken from publications issued in the decade ending in 1965. The bibliography lists nine, only nine, items under the headings "dissertations" and "theses"; less than 0.2 percent of the entries, therefore, specifically pertain to dissertations.[12]

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[11]Norman D. Stevens, a review of Management Personnel in Libraries: A Theoretical Model for Analysis, by Kenneth Plate, in Library Resources and Technical Services, XXXI (Summer, 1971), 419.

[12]Bureau of Information Sciences Research. Graduate School of Library Service. Rutgers-The State University, Bibliography of Research Relating to the Communication of Scientific and Technical Information (New Brunswick, N.J.: Rutgers University Press, 1967), pp. 630,723.

An examination of current indexes in the course of the investigation reported in this paper attests to the continued paucity of materials about the dissertation while other facets of doctoral education and doctoral recipients continue to be the focus of research efforts.

An exception to the last statement is the inquiry undertaken by the Center for Research Libraries in 1970. Libraries which held membership in the Center were contacted by questionnaire in order to determine the extent to which each library acquired dissertations. The aggregate of expenditures for dissertations among member libraries responding to the questionnaire was less than $50,000,[13] an amount smaller than most members' annual expenditure for monographs. From these data, it appears as if research libraries acquire for use by their own constituencies only a fraction of the dissertations produced annually in American universities.

If dissertations are not acquired extensively by research libraries (and, by extension, other libraries) in their original format, do dissertations serve as information sources for publications in the traditional information/communication flow in formal channels of open literature, i.e., literature published for distribution through existing wholesale/retail outlets? Few empirically-derived data have been published on this question.

To provide empirical data about the dissertation as an information source, an investigation was undertaken to assess diffusion and

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[13]Center for Research Libraries, "An Investigation of a Proposal to Acquire U.S. Doctoral Dissertations at the Center for Research Libraries," Chicago, 1970. (unpublished report)

assimilation patterns of dissertation contents. The assessment was based upon an analysis of patterns of (1) diffusion of dissertation contents in the open literature of botany, chemical engineering, chemistry, and psychology and (2) assimilation of dissertation contents from the original format as reflected by citations to the dissertation itself. The four disciplines selected were chosen to facilitate comparison and contrast of patterns of diffusion and assimilation in each of the four broad divisions of science.

Data for the study were obtained from two sources: (1) dissertation authors included in the study were asked to provide bibliographic citations to publications they had produced based primarily upon the dissertation and to categorize authors citing the dissertation into one of six categories representing acquaintance-relationship levels and (2) Science Citation Index was examined to identify citations of dissertations included in the study.

The study is described in the remainder of this paper, consisting of four chapters. Chapter II is a literature review; Chapter III describes research design and methodology; Chapter IV presents data collected and an analysis of the data noting similarities and dissimilarities; and Chapter V presents conclusions and implications drawn from the investigation and raises further basic research questions. The chapters are supplemented by data presented in the Appendix.

CHAPTER II

REVIEW OF RELEVANT LITERATURE

To guide the exploratory study reported in this paper, the literatures of several diverse disciplines (for example, library and information science, chemistry, higher education, sociology, mass communications, and psychology) were examined to extract information about dissertations, the process of graduate education which produces the doctorate, communication of scientific and technical information, and citations and citation indexing. Following the literature review, implications were drawn concerning the role of the dissertation as a communications vehicle.

The literature review begins with an examination of the research-base upon which a doctorate rests, including historical developments, trends, and current issues involving graduate education and the doctorate. Note is made of the proliferation of doctorates and of the projections of the number of doctorates likely to be produced in the coming decade. Special attention is paid to the production of doctorates in the sciences, the focus of this investigation.

Statements of graduate schools concerning the nature of the dissertation are then examined and divergent opinions on the proper role of the dissertation reviewed. Data are extracted from empirical studies concerning the place of the dissertation in scientific and technical communication as indicated by user studies and analysis of materials

cited in subsequent publications.

An examination of the role of communication among scientists and technologists in the dissemination of research results is included inasmuch as the dissertation is a vehicle for research results and the focus of this investigation is dissertations in the sciences.

The literature review is concluded by an examination of citations and citation indexing, tools employed in the investigation reported here to assess diffusion and assimilation patterns for dissertation contents among the disciplines of botany, chemical engineering, chemistry, and psychology.

The Ph.D. dissertation is the capstone to a formal academic training process which begins with the doctoral recipient's entrance into elementary school or into kindergarten. For many doctoral recipients, the process consumes more than twenty years.

History of the doctorate

The precise date of the first doctorate is unknown; however, the history of the degree dates back some seven centuries. ". . . the first university doctorates were probably the Doctor of Civil Law and the Doctor of Canon Law awarded by Bologna in the twelfth century for the completion of its courses of study in law."[1] In tracing the rise of the doctorate throughout Europe, Schweitzer notes almost from its inception the prestige of the degree as a ". . . highly-significant acknowledgement of intellectual nobility."[2]

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[1]George K. Schweitzer, The Doctorate: A Handbook (Springfield, Ill.: C. C. Thomas, 1965), p. 6.

[2]Ibid., p. 8.

Centuries later, in the contemporary world of learning, the doctorate continues to carry similar connotations. Likewise, two other facets of the degree process, once integrated into the program, have remained virtually unchanged:

> Educational authorities came to recognize the desirability for the university professor to be a research investigator as well as a teacher. Original work became a part of university training. . . . The performance of original research became a requirement for almost all doctor's degrees.[3]

As noted in the previous chapter, the earned doctorate was first introduced in the United States in 1861. In that year Yale University awarded this nation's first earned doctorates, three Ph.D.'s in psychology, physics, and classics.[4]

Fifteen years after the first earned doctorates were awarded by Yale, the model of graduate education with which modern educators are familiar was established in this country. At Johns Hopkins University, the first distinct effort to offer graduate education in this country was undertaken in 1875. The program offered was intentionally closely modeled after graduate education in Germany. The Germanic influence has played a decisive role in the formation of the character of graduate education in the United States, especially in doctoral education. Rudy, in reviewing higher education in the United States, observes, ". . . the German university spirit of search for knowledge and its concomitant

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[3]Ibid., p. 11.

[4]Everett Walters, "Graduate Education, 1862-1962," in A Century of Higher Education: Classical Citadel to Collegiate Colossus, ed. by William W. Brickman and Stanley Lehrer (New York: Society for the Advancement of Education, 1962), p. 124.

emphasis of productive research [emphasis added] were transplanted in large measure to America."[5] Following the founding of Johns Hopkins University, Clark University (1887), and the University of Chicago (1891), this nation had established a pattern of graduate education which exists today.

> Requirements for graduate degrees, quite remarkably, have remained unchanged. From the earliest days to the present [1962], the doctorate represents approximately three years full-time academic work beyond the baccalaureate, a knowledge (more or less) of foreign languages, a general examination, and an acceptable dissertation (usually defined in the past as a contribution to knowledge).[6]

Following more than a century of graduate education in which some 340,000 doctorates (not including doctoral degrees at the first professional level) have been conferred, the apparent unchanging character of the degree belies the controversies which have at times raged about the proper character of graduate education itself. Commentaries on the process, its strengths and weaknesses, its problems and their solutions, have been expressed by such disparate authors as the disenchanted doctoral student and a former President of the Carnegie Foundation for the Advancement of Teaching.

Bernard Berelson aptly describes the voluminous literature on graduate education in the following observation.

> Thus the debate over the very conception of doctoral study goes on: Is it one thing or several? Is it academic or professional? Is it supposed to produce the educated man or the skilled

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[5]Willis Rudy, "Higher Education in the United States, 1862-1962," in A Century of Higher Education: Classical Citadel to Collegiate Colossus, ed. by William W. Brickman and Stanley Lehrer (New York: Society for the Advancement of Education, 1962), pp. 20-21.

[6]Walters, op.cit., p. 129.

> specialist? Is it for college teaching or for research? The debate is a mixture of dedicated conviction, alleged facts, cliches and prejudices, differences by field and type of institution, solid arguments, low motives and high ideals.[7]

Prior, like Walters, contends that very little has changed. In reflecting upon the evolution of graduate education in this country, Prior observes:

> In specific details there have been changes over the years: the requirement for the dissertation to be published has been abandoned; the language requirement has become less inflexible; formal course work has, perhaps unfortunately, been increased; and the qualifying examination, usually written, has become almost universal and has replaced in importance and in rigor the old oral "defense of the thesis." In the main, however, the basic aims and expectations have remained unaltered in essence.[8] (emphasis added)

From graduate catalogs and bulletins of representative universities throughout the country come contemporary statements on the nature of the doctorate. Throughout these statements appears over and over the requisite of research.

> The degree Doctor of Philosophy is conferred in recognition of marked ability and scholarship in some relatively broad field of knowledge. . . . In addition, the student must conduct independent investigation . . . and must present the results of his investigation in the form of a dissertation.[9]

> The degree [Ph.D.] is awarded in recognition of a candidate's knowledge of a broad field of learning and his distinguished accomplishment in that field through an original contribution of significant knowledge and ideas. The candidate's research must reveal high critical ability and powers of imagination and synthesis.[10]

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[7]Bernard Berelson, Graduate Education in the United States (New York: McGraw-Hill, 1960), p. 92.

[8]Moody E. Prior, "The Doctor of Philosophy Degree," in Graduate Education Today, ed. by Everett Walters (Washington, D.C.: American Council on Education, 1965), p. 35.

[9]Horace H. Rackham School of Graduate Studies, 1970-71 (Ann Arbor, Mich.: University of Michigan, 1970), p. 50.

[10]General Catalog (Berkeley, Calif.: University of California, Berkeley, 1971), p. 34.

> The Doctor of Philosophy degree is awarded after the successful completion of a program of advanced study extending the frontier of knowledge and an original investigation reported in an approved thesis.[11]

Despite the often heated and voluminous controversy of what the Ph.D. degree ought to be, the quotations leave little doubt of what universities purport the very foundation of the degree to be: research.

The Ph.D. process

Any research efforts which add to man's knowledge are worthy of attention. A process involving a current production rate of more than 33,000 investigations purporting to add to man's knowledge surely demands attention. To capture the magnitude of the process, some brief historical data are offered, supplemented with projections into the next decade.

From a modest beginning in 1861, the number of doctorates conferred annually in this country increased with a regularity and in proportions greater than those of scientific literature, especially the scientific periodical, which has become the main vehicle of formal scientific and technical communication. Price, in commenting upon the growth of scientific literature, notes: ". . . it is immediately obvious that the enormous increase in the population of scientific periodicals has increased from unity [in 1665] to the order of a hundred thousand with an extraordinary regularity seldom seen in any man made or natural

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[11] General Announcements for the Academic Year, 1971-1972 (Houston: William Marsh Rice University, 1971), p. 109.

statistic."[12, 13] The worldwide growth of scientific and technical periodicals observed by Price encompassed a period of some three hundred years. Within a period approximately one-third the length, the production of doctorates reached a cumulative total of approximately 340,000 in this country alone. The magnitude of the process which produces this total is striking in and of itself; however, it is even more awesome to note that another 340,000 doctorates are likely to be produced in the present decade, 1971-1980.

With each degree conferred, another research project has been completed and the results reported in a dissertation. Each dissertation represents a refereed paper, supervised by an advisor whose competence in the field is acknowledged by the position he holds within the university and subject to the criticism and guidance of two to six other similarly distinguished individuals. The research completed under such stringent conditions surely is of no less value than that completed in laboratories and workshops outside the halls of academe.

Of special interest is the number of doctorates produced in this country in the sciences, the focus of the investigation reported in this paper. Inspection of data concerning production for the past several years indicates that approximately one-half of all doctorates are awarded in the sciences. A sense of perspective of the number of

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[12]Derek J. de Solla Price, Science Since Babylon (New Haven, Conn.: Yale University Press, 1971), p. 96.

[13]Although the historical data upon which Price bases his observations are sound, the projection he makes has been questioned. See K. P. Barr, "Estimates of the Number of Currently Available Scientific and Technical Periodicals," Journal of Documentation, XXIII (June, 1967), 110-16.

science doctorates produced may be gained by comparing their production rate to that of book titles in this country.[14] Using data for dissertations produced in 1969-1970[15] and for book title production for 1970,[16] it is found that 29,572 dissertations were produced and 36,071 book titles were published.

Each of the dissertations reported the results of research completed; each dissertation by its very nature represented a refereed, scholarly monograph. Of the 36,071 book titles, 11,783--nearly one-third--were new editions; of the remaining 24,288 titles, 2,640 were juveniles and 3,137 were fiction, leaving 18,511. Of the 18,511 many were unrefereed (vanity publications) or of an introductory level adding little or nothing of a scholarly interest. Through extrapolation, possibly less than 10,000 of the 36,071 book titles published in 1970 might warrant the label "scholarly title," a figure less than one-third of the number of dissertations produced during approximately the same period.

Viewed from another approach, some 6,500 new book titles published in 1970 were classified in one of the pure or applied sciences. If the non-scholarly titles are removed (through the process of extrapolation), it is certain that some 15,000 dissertations produced in the pure

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[14]As data for dissertations produced are reported for an academic year, e.g., 1969-70, and as book title production is reported for a calendar year, the periods do not entirely coincide; however, both periods encompass twelve months.

[15]American Doctoral Dissertations, 1969-1970, Compiled for the Association of Research Libraries (Ann Arbor, Mich.: University Microfilms, 1971), pp. xvii-xix.

[16]"1970: A Big Boost in Book Titles . . . as Recorded in PW," Publishers' Weekly, CXCIX (February 8, 1971), 32-3.

and applied sciences more than double the output of scholarly monographs in this country and possibly even triple that output.

Costs of doctoral education

While the investment in the production of doctorates in this nation surely produces nothing less than a great national resource, the extent of the investment at all levels and from all sources is difficult to assess accurately. The production of doctorates occurs in colleges and universities throughout the country that range across the entire spectrum of higher education. Unfortunately for many purposes, the costs of supporting doctoral education in these institutions are not conveniently separated from those required to maintain facilities and processes, e.g., buildings, libraries, and administrations, from which all students within the institution draw benefits.

Cost figures, therefore, at the national level must be approximations. In the process of approximation, interpretation, and extrapolation, discrepancies do arise; yet, the most conservative cost figures underline the great investment made annually in this country in graduate education.

The extrapolation of the costs of producing a doctorate in the sciences cited in the previous chapter, $62,000, accounts for only the financial cost of money expended by the university; not included within the figure is an estimation of the value of the time invested by the student. The figure becomes even more inflated if the time invested by students who do not complete a degree program is calculated and this figure distributed among those who do complete a program.

The investment in time required to attain the doctorate cited in the last chapter is likewise understated. The figure of 5.4 years as the median time required between baccalaureate and doctorate is misleading in that: (1) it represents only the median registered time and (2) the period most nearly approximates a transfer pattern in which the baccalaureate and doctorate were received at the same institution without receipt of an intermediate master's degree. For a transfer pattern in which the baccalaureate and master's degree were received at one institution and the doctorate at another, the elapsed time was 9.8 years; for a pattern in which all three degrees were conferred by different institutions, the elapsed time was 11.8 years.[17]

The apparent surplus of doctorates in some fields,[18] the reallocation of federal and state funds once expended on higher education, the implementation of new degree programs to prepare college and university teachers,[19] and even modification of the Ph.D. itself[20] may alter in some

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[17]National Science Board. National Science Foundation, Graduate Education; Parameters for Public Policy (Washington, D.C.: National Science Foundation, 1969), p. 25.

[18]Harold P. Hansen, The Ph.D. Surplus-Realities and Illusions (Washington, D.C.: Council of Graduate Schools in the United States, 1970).

[19]Many programs have been proposed to improve the preparation of college and university teachers. Often such proposals have presented alternatives to the Ph.D. degree. One of the proposals that embodies elements of needs and solutions found in a number of other proposals is Oliver C. Carmichael, Graduate Education: A Critique and A Program (New York: Harper & Brothers, 1961).

[20]Publications have appeared in many disciplines voicing a myriad of proposals which would reduce the cost in money and time while maintaining or increasing the effectiveness of the Ph.D. degree itself. The proposals range from greater selectivity of candidates to increased funding of assistance to restructuring the requirements of the degree program, i.e., fewer required courses, abolition of the language requirements, etc.

It should be noted, however, that few proposals would alter the research base of the degree.

measure the investment required individually and collectively to support doctoral education. The fact remains, however, in the interim period the total expenditure for graduate education in this country amounts to an enormous economic investment in a process purporting to involve research whose results are contained in the dissertation. While it would be misleading to imply that the only benefits which accrue from the investment in doctoral education are dissertations, it is equally misleading not to underline the expense involved in the production of these dissertations and to underscore the potential wealth of research data contained therein.

The production of Ph.D.'s has been doubling consistently every six years; 1 percent of the babies born in 1943 has received or is in the process of attaining a doctorate. Hansen projects that the production rate will level off at not less than 6 percent.[21, 22]

The dissertation

Two definitions of a dissertation were given in Chapter I. Similar definitions are presented below, representing an array of doctoral granting institutions, public and private, large and small, Land Grant and Ivy League; yet, within the extracts presented is a common theme--the dissertation is a vehicle to carry the results of research undertaken while the student was a candidate for the doctorate.

> The Doctor of Philosophy is primarily a research degree and the candidate must demonstrate his capacity for independent research

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[21] Hansen, op.cit., p. 3.

[22] The estimate by Hansen may be inaccurate; however, any error less than some 83 percent will still result in a rise in the production of doctorates; of course, the smaller the error, the greater the ensuing increase.

by the production of an original thesis on a topic within his major field of study. (Illinois)[23]

The dissertation must show that the candidate has technical mastery in his field and is capable of independent research. The study must enlarge or modify what was known, or present a significant interpretation. (Princeton)[24]

Each student working toward a doctoral degree must conduct original research upon which a thesis is to be prepared . . . . (Michigan State)[25]

The dissertation must report original research in some area of engineering or applied science, and demonstrate creative thought and scholarly achievement by the student. (Yale)[26]

Recommendation for the degree [Ph.D.] will be made only after the acceptance of a dissertation, which must be a contribution to knowledge and the result of independent work, expressed in satisfactory form. (Stanford)[27]

The dissertation is the report of an original investigation carried on by the Candidate under the direction of his committee. It is expected that the topic selected for study will be one of significance and importance to the Candidate's field of specialization, but at the same time one which is not beyond the experience and ability of the Candidate to bring to successful completion. (Michigan)[28]

The dissertation is expected to be of such scope, independence, and skillful presentation as to indicate that the candidate has acquired a command of his subject, that he has the ability to

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[23]The Graduate Catalog (Urbana, Ill.: University of Illinois, Urbana-Champaign, 1969), p. 40.

[24]Princeton University, The Graduate School Announcement, 1971-1972 (Princeton, N.J.: Official Registrar of Princeton University, 1971), pp. 22-3.

[25]Description of Courses and Academic Programs for Graduate Study 1970 (East Lansing, Mich.: Michigan State University, 1970), p. 52.

[26]Graduate Study in Engineering and Applied Science, 1971-72 (New Haven, Conn.: Yale University, 1971), p. 21.

[27]Bulletin (Stanford, Calif.: Stanford University, 1971), p. 11.

[28]Horace H. Rackham School of Graduate Studies, 1970-71 (Ann Arbor, Mich.: University of Michigan, 1970), p. 56.

> contribute fresh knowledge or a fresh outlook to his subject, and that he is a master of the research methodology of the discipline. (University of North Carolina)[29]
>
> It [the dissertation] should represent a significant contribution to knowledge, be presented in a scholarly manner, reveal an ability on the part of the candidate to do independent research of high quality, and indicate considerable experience in using a variety of research techniques. (Pennsylvania State)[30]

From the above quoted extracts from university bulletins, the role of the dissertation seems quite well defined as a vehicle to carry the results of independent investigation undertaken by a candidate for the doctoral degree. As a vehicle for research results, the dissertation becomes part of the dissemination process.

The role of dissemination of research results as an integral part of the research process seems well established. In addition to the statement from the SATCOM Report quoted in Chapter I, a second statement by a national policy planning body is offered as evidence of the universality of the belief.

> Transfer of information is an inseparable part of research and development. All those concerned with research and development--individual scientists and engineers, industrial and academic research establishments, technical societies, Government agencies--must accept responsibility for the transfer of information in the same degree and spirit that they accept responsibilities for research and development itself.[31]

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[29]Record of the University of North Carolina at Chapel Hill, The Graduate School, Announcements for the Session 1971-1972 (Chapel Hill, N.C.: University of North Carolina Press, 1971), p. 97.

[30]1971-1972, The Pennsylvania State University: Graduate Degree Programs (University Park, Penn.: Pennsylvania State University, 1971), p. 65.

[31]U.S. President's Science Advisory Committee, Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information (Washington, D.C.: Government Printing Office, 1963), p. 1.

By extension, the same proposition applies to all disciplines. In view of the purported research-base of the doctorate and the increasing annual production of dissertations in this country, the role of dissemination of dissertation-research results assumes great importance.

There has been a veritable flood of data published based upon empirical investigations into the nature of the process which culminates in the doctorate; there has been a similar number of investigations into the individual doctoral recipient, both before and after the degree was conferred. Conversely, there has been a dearth of empirically-derived data about dissertations. Beyond the descriptive statistics of the number accepted annually and a concomitant analysis by discipline or field, there is an almost total void of knowledge about the dissertation as a vehicle for the dissemination of research results.

There are investigations which do provide some insight into the dissertation. With one exception,[32] the focus of the investigation was not the dissertation itself but an educational or communications process which involved the dissertation as a product, vehicle, or channel as one part of the total educational or communications process. There is a second body of literature which discusses dissatisfactions and recommendations for improvement of the dissertation.

Dissatisfactions with the dissertation are not wholely separable from the process which produces the doctorate. An example of the difficulty of separating the two may be drawn from a statement by Grigg: "The

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[32]Walter E. McPhie, "Factors Affecting the Use and Value of Dissertations in Social Studies Education," (unpublished Ph.D. dissertation, Stanford University, 1959).

dissertation has been a stumbling block for many students, and has contributed more than is warranted to an extended length of elapsed time between matriculation and graduation."[33] The difficulty of separating the research project and the preparation of the results should not be minimized. Often what has been attributed to the dissertation as unnecessary delay should have been ascribed to the research effort prematurely completed or to an inhospitable environment for cooperative efforts necessary to expedite writing the dissertation.

Grigg continues his assessment of the dissertation noting that many educators suggest that imparting research expertise is:

> . . . the purpose of the dissertation, which traditionally was to be an original and significant contribution to knowledge. But the time required for the completion of such a project may be inordinately long, and in turn the original intent has been modified. Lip service is still given to the original concept, but in practice the dissertation is becoming more and more a training instrument.[34]

While the statement contradicts contemporary statements from university bulletins quoted above, Grigg is not alone in observing that some modifications in the original intent of the dissertation have either taken place or should take place.

> Fortunately, the old monumental, life-sentence, eiderdown-quilt dissertation, which I described and deplored in Teacher in America, is receding into the past.[35]

> Everybody knows about the ordeal of the dissertation. Since I described it twenty years ago in Teacher in America, the only

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[33]Charles M. Grigg, Graduate Education (New York: The Center for Applied Research in Education, Inc., 1965), p. 61.

[34]Ibid., pp. 61-2.

[35]Jacques Barzun, The American University: How It Runs: Where It Is Going (New York: Harper & Row, 1968), p. 36.

> sign of betterment is that which President Kirk mentioned as a prediction in 1964--that it will in future be considered not as an addition to knowledge but "a trial run in research." Sensible departments so regard it, but tacitly.[36]

Carmichael emphasizes that, in spite of similarity among graduate catalog statements, a consensus among educators of what constitutes a dissertation has not yet been achieved.

> The character and purpose of the dissertation itself are not agreed upon. In a recent list one dissertation was 26 pages long; another, 326, and others ran as high as 1,000 pages. It is clear from an examination of topics listed that no common agreement has been reached as to whether the dissertation should be original work, creative work, an account of research in the laboratory, a collection and organization of facts to prove a thesis or a contribution to knowledge.[37]

Yet, dissertation supervisors and committee members who have served as advisors to authors of each type of paper labeled by Carmichael could marshal, no doubt, compelling reasons why each is legitimately a dissertation within the broad framework of what constitutes research. Logically all may be equally valid dissertations.

Some writers, e.g., Williams[38] and Wolff,[39] would abandon the dissertation except in rare occasions. While the impetus for discarding the dissertation in each instance arises from different causes, in neither case does the writer question the value of reporting the results of investigations completed if the project be a worthy one. Again the

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[36] Ibid., pp. 261-62.

[37] Carmichael, op.cit., p. 48.

[38] David C. Williams, "Stop the Dissertation!" Educational Leadership, XXVIII (April, 1971), 753-56.

[39] Robert P. Wolff, The Ideal University (Boston: Beacon Press, 1969).

separation of research and the dissemination of research results is difficult. Seemingly Carmichael, Williams, and Wolff question the value of the research undertaken and not the proposition that dissemination of research results is an integral part of the research process.

Turning from commentaries on the value of the dissertation to studies reporting empirical data about the role of the dissertation, an almost total void of published works is encountered. The dissertation by McPhie, cited above, is the only extended work focusing upon the dissertation to come to the attention of this investigator.

A summary of the McPhie dissertation was published in Social Education.[40] The thrust of the investigation was three-fold: (1) to assess the research experience, (2) to examine subject areas in social studies education receiving emphasis in doctoral research efforts, and (3) to explore patterns of dissemination of research results.

Of special relevance are the data reported by McPhie concerning the dissertation as an information source in social studies education. From an examination of library circulation records, he concludes that for those dissertations for which data were available nearly three-fourths had been used (checked-out) no more than twice each year. Inter-library loans of dissertations revealed that one-third had never been loaned outside the institution and only four of those for which data were available (some 205) had circulated outside the institution more than ten times.[41]

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[40]Walter E. McPhie, "Factors Affecting the Value of Dissertations," Social Education, XXIV (December, 1960), 375-77, 85.

[41]Ibid., p. 377.

Subsequent publication patterns revealed that nearly two-thirds of the authors for which data were available had not published anything based upon their dissertation. McPhie concluded his review by recommending that, "Each doctoral student should be responsible for publishing at least one good summary article of his thesis in a professional journal that will reach the most appropriate group of readers."[42] Data from the study suggest that authors of dissertations view their research process as worthwhile, individually and to the field; yet, McPhie concludes that the worth of the dissertation is potential rather than realized due to the inadequate dissemination process.

During the year following McPhie's dissertation, the results of Berelson's inquiry into graduate education were published as Graduate Education in the United States.[43] The far-reaching impact of the work is underscored by the frequency with which it is still cited. For those who wish to familiarize themselves with graduate education--its problems, trends, and future--Berelson's work is still a point from which to begin a thorough examination. The report was based upon data derived from questionnaires to graduate deans, graduate faculty members, recent recipients of the doctorate, and college presidents together with representatives of industry. It summarizes the opinions of some 4,700 individuals who shared an interest in graduate education.

A section of the report presents findings concerning the dissertation. Following an introductory summary on the purpose of the

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[42] Ibid., p. 385.

[43] Berelson, op.cit.

dissertation, noting problems which have arisen in achieving the stated purpose, Berelson presents data on (1) the value of the dissertation as a primary contribution to knowledge and as a research training device; (2) the value derived from completion of a dissertation balanced against the investment of time and money; (3) topic selection; (4) amount of attention, direction, supervision, etc. accorded the student; (5) time required to complete the degree; and (6) the length of dissertations.[44]

The table below taken from Berelson suggests that a number of individuals view the dissertation as a training device rather than a vehicle for reporting the results of original research; however, it should be noted that training and research are not mutually exclusive activities.

In spite of the number of topics covered within his discussion of dissertations, Berelson makes only one recommendation:

> The dissertation should be shorter. . . . No fixed number of pages can be set for a dissertation, considering the range of fields and topics. But to give a sense of order of magnitude, I suggest aiming at a median of 100 pages or so in fields where that is not now the practice.[45]

Respondents to Berelson's questionnaire provided data presented below in reply to the following two questions:

> Regardless of what the formal requirements are, do you think that the value of the dissertation is primarily as an original contribution to knowledge or primarily as an exercise in research training? In your view, which should it be?[46]

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[44] Ibid., pp. 172-85.

[45] Ibid., p. 239.

[46] Ibid., p. 174.

	Graduate faculty		Recent Ph.D. recipients	
	Is	Should be	Is	Should be
Primarily contribution to knowledge	15%	25%	26%	25%
Primarily research training	57%	31%	31%	18%
Both equally	26%	42%	42%	56%
Can't say	2%	2%	1%	1%

When asked by Berelson what the most and least valuable parts of the doctoral training process were, 75 percent of the graduate faculty and 82 percent of the recent Ph.D. recipients contacted agreed that the dissertation work was the most valuable.[47] To another question, 69 percent of the graduate faculty responded that the dissertation was "OK as is."[48]

Other than the investigation by McPhie and the inquiry by Berelson, there appears to be a void of extended discussions of the dissertation as the focus for an investigation or the focus of an extended part of a larger research project. Dissertations do appear as communication vehicles or channels in several studies in communication, especially in science and technology.

Communication among scientists and technologists

The reasons why people communicate with one another are complex and varied, generally not amenable to simplistic categorization. Passages from the report of the President's Science Advisory Committee stress the role of communication in the advancement of science and technology.

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[47] Ibid., p. 206.

[48] Ibid.

> Science and technology can flourish only if each scientist interacts with his colleagues and his predecessors, and only if every branch of science interacts with other branches of science. . . .[49]

> An operational analysis of the process of technical discovery made by the Panel suggests that the individual theoretical scientist will, on the average, maximize his overall productivity if he spends half of his time trying to create new scientific information and half of his time digesting other work and communicating his own.[50]

> Research and development cannot be envisaged without communication of results of the research and development. . . .[51]

In the SATCOM Report several perceptive insights into why people communicate are offered. Again the complexity of reasons why communication takes place are apparent.

> The originators and users of scientific and technical information are largely the same individuals, for almost everyone who generates scientific and technical information also makes use of it . . . .
> . . . . . .
> Ideally, the technical paper serves the purpose of reporting significant research results for the advancement of human knowledge and the betterment of mankind. Were this its only purpose, publication should be assured and provided completely at public expense. In the real world, the situation is not this simple; other reasons [for communication and publication] include arbitrary external requirements, professional advancement, kudos of various kinds, and money.[52]

In expanding upon the above observations, the SATCOM Report enumerates reasons why three segments of the originator population communicate.

> (Individuals) 1. Maintain or enhance their professional status and recognition in a particular field or within an organization
> 2. Develop a better resume and list of publications in order to establish a better bargaining position for salary reviews or job interviews
> 3. Conform to traditions of science by making their work available upon completion for judgement by their peers and colleagues
> 4. Obtain satisfaction from seeing their work in print

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[49]U.S. President's Science Advisory Committee, op.cit., p. 7.

[50]Ibid., p. 10. [51]Ibid., p. 14.

[52]SATCOM, op.cit., pp. 100-01.

5. Facilitate new contacts with others doing similar work

(Organizations) 1. Establish or maintain, for purposes of recruiting, sales, or project support, a public image of their organization as a place where most of the work, or most of the interesting work, in a field is taking place

2. Obtain a measure of productivity and quality of efforts of professional staff

3. Develop better staff bibliographies to enhance sales proposals or to satisfy necessary accreditation procedures

4. Advertise particular products or services

5. Reinforce patent protection and obtain royalties or revenues from public sales

(Professional organizations and societies) 1. Improve the profession and its skills

2. Sustain their programs of services to members, such as publications and conferences

3. Maintaining their status as active organizations and thus encouraging increased membership.[53]

From the above enumeration, it is clear that it would be difficult if not impossible to identify which reasons caused a particular communication, whether it be written or oral. To satisfy one condition and only one is rarely if ever possible.

Reasons for the dissemination of research results produced during work for the doctorate clearly may fall within many of the categories listed. Surely there are reasons why each of the three originators listed above have vested interests in wishing that the results of the doctoral research as reported in the dissertation be disseminated to interested audiences. During the literature review no qualitative difference between the information contained in dissertations and that scientific and technical information discussed in the two technical reports quoted on the preceding pages was discerned. Seemingly there are no reasons why the propositions expressed about scientific and technological literature do not also cover dissertations.

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[53] Ibid., p. 101-02.

In view of the importance ascribed to communication, especially scientific and technical communication, it is surprising that knowledge about communication/information behavior is so undeveloped and so lately the focus of investigations. The recently inaugurated Annual Review of Information Science and Technology is a veritable wellspring of materials of interest to those who seek a better understanding of communication/information behavior; yet, many review authors introduce their chapter with an observation on the paucity of materials to review.

From materials reviewed in the foregoing title, it is apparent that large segments of the communication/information area are only now beginning to be understood and investigated. A prime example is the area of informal communication. Only recently, from the complex "mosaic" formed by data from many empirical and theoretical studies, does the process become clear of how individuals keep informed about a rapidly developing area in spite of delays inherent within the formal communications system. Work by Crane,[54] Garvey, Lin, and Carnot,[55] Menzel,[56] Crawford,[57] and Rosenbloom and Wolek[58] are examples of the very recent

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[54]Diana Crane, Invisible Colleges; Diffusion of Knowledge in Scientific Communities (Chicago: University of Chicago Press, 1972).

[55]William Garvey, Nan Lin, and Nelson Carnot, "Some Comparisons of Communication Activities in Physical and Social Sciences," in Communication Among Scientists and Engineers, ed. by Carnot E. Nelson and David K. Pollack (Lexington, Mass.: Heath Lexington Books, 1970).

[56]Herbert Menzel, "Informal Communication in Sciences: Its Advantages and Its Formal Analogues," in The Foundations of Access to Knowledge, ed. by Edward B. Montgomery (Syracuse, N.Y.: Syracuse University, 1968).

[57]Susan Y. Crawford, "Informal Communication Among Scientists in Sleep and Dream Research" (unpublished Ph.D. dissertation, University of Chicago, 1970).

[58]Richard S. Rosenbloom and Francis W. Wolek, Technology and Information Transfer: A Survey of Practice in Industrial Organizations (Boston: Division of Research. Graduate School of Business Administration. Harvard University, 1970).

extended cognizance of the topic. These reports on informal channels make it necessary to recognize that the dissertation may serve as an information source for informal as well as formal communication.

With the increased understanding of communication/information behavior provided by investigations in many fields, an appreciation of the rather tenuous "ecological" relationships among various forms of communication is held by many investigators. One of the earlier writings on such topics serves as an example; Kilgour contended in a paper presented in 1966 at the annual meeting of the American Documentation Institute that altering the traditional mode of announcing research results through journals by making the results available from a central repository defeats many of the purposes which give impetus to the author's desire to publish research results.[59]

A second example of the dysfunctional consequences of informal communication of research results is the informal, unrefereed exchange of papers undertaken in the late 1960's. Several such projects were established within narrow specializations within the sciences. Several of the projects were quite successful when measured against the criteria upon which the experiments were initiated. Confrey's letter announcing the discontinuation of the "Information Exchange Groups" leaves no doubt that the projects were successful.[60] An extended discussion of one of the informal exchange groups, a project in physics, is reported by Libbey

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[59]Frederick G. Kilgour, "Publication of Scientific Discovery: A Paradox," in Proceedings of the 1966 ADI Annual Meeting, ed. by Don V. Black (Woodlands, Calif.: Adrianne Press, 1966).

[60]Eugene A. Confrey, "Information Exchange Groups To Be Discontinued," Science, CLIV (November, 1969), 843.

and Zaltman.[61] A rejoinder to the project and its proponents is offered by Pasternack, who discusses the injurious effects of such systems, demonstrating clearly the interlocking parts of the communications system.[62]

Citations and citation indexing

Citations and citation indexing have been applied as tools in a number of research projects spanning nearly fifty years. As tools utilized in the present investigation, a literature review was undertaken to ascertain information about the ways in which the two had been successfully employed in prior research projects. The review yielded two forms of information about the two tools: (1) information about each term and (2) data about dissertations as a form of literature studied in various research projects utilizing citations and/or citation indexing as research instruments.

Relevant literature about citations and citation indexing is scattered among literatures of many disciplines: library and information science, education, physical and biological science, psychology, and sociology represent primary sources.

Citations have proved to be a versatile research instrument in a number of research projects. Two major thrusts using citations are reported in various literatures: (1) the identification of key journals and individuals within fields and (2) the assessment of individual

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[61]Miles A. Libbey and Gerald Zaltman, The Role and Distribution of Written Informal Communication in Theoretical High Energy Physics (New York: American Institute of Physics, 1967).

[62]Simon Pasternack, "Criticism of the Proposed Physics Information Exchange," Physics Today, XIX (June, 1966), 63.

productivity and quality of publications.

The extension of such studies has been facilitated by the appearance of Science Citation Index (hereinafter referred to as SCI) in 1963. Eugene Garfield, President of the Institute for Scientific Information, publisher of SCI, defines a citation index as:

> . . . an ordered list of cited articles [now extended to all forms of literature including informal communications] each of which is accompanied by a list of citing articles. The citing article is identified by a source citation, the cited article by a reference citation. The index is arranged by reference citations.[63]

The assimilation of citations from some 2,000 journals arranged by author cited has made possible studies heretofore economically not feasible.

A reliance upon citations in research must take cognizance of the wide range in the application of references appended to a work. Price observes:

> One cannot assume that all authors have been accurate, consistent, and conscientious in noting their sources. Some have done too little, and others too much. But it is generally evident from a long run of any scientific periodical that around 1850 there appears the familiar modern pattern of explicit reference to previous work on which rests the distinct, well-knit addition that is the ideal burden of each paper.[64]

"The Norms of Citation Behavior,"[65] by Kaplan, is a source of additional insights into the phenomenon of the footnote. In examining the social system of science and footnoting practices, Kaplan inquires whether one may not affect the other. If so, then researchers employing citations

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[63]Eugene A. Garfield, "'Science Citation Index'--A New Dimension in Indexing," Science, CXLIV (May, 1964), 650.

[64]Derek J. de Solla Price, Little Science, Big Science (New York: Columbia University Press, 1963), pp. 64-5.

[65]Norman Kaplan, "The Norms of Citation Behavior: Prolegomena to the Footnote," American Documentation, XVI (July, 1965), 179-84.

as a tool must be cognizant of the potential effects of such interactions.

Many of the applications envisioned by Kaplan in the quotation below have already been applied in research efforts, attesting to the versatility of the footnote or citation in research projects.

> A partial list of such uses would include attempts to "define" an emerging field of inquiry, or even an existing one which is not confined to a single set of journals within the normally recognized academic field; to help identify "important" papers, scientists, or journals; to identify the effective life, the true half-life, the back half-life, etc., of scientific papers; as an index of the "quality" of a man's paper in conjunction with the quality of his publications.[66]

Weinstock introduces indirectly in enumerating reasons for using citations the realization that all citations are not of equal value, a fact seemingly overlooked by some investigators using citations as a research tool. Weinstock observes that citations are employed as a means for:

1. Paying homage to pioneers.
2. Giving credit to related work.
3. Identifying methodology, equipment, etc.
4. Providing background reading.
5. Correcting one's own work.
6. Correcting the work of others.
7. Criticizing previous work.
8. Substantiating claims.
9. Alerting researchers to forthcoming work.
10. Providing leads to poorly disseminated, poorly indexed, or uncited work.
11. Authenticating data and classes of fact--physical constants, etc.
12. Identifying original publications in which an idea or concept was discussed.
13. Identifying the original publication describing an eponymic concept of terms as, e.g., Hodgkin's disease, Pareto's Law, Friedel-Crafts Reaction.
14. Disputing priority claims of other.[67]

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[66] Ibid., p. 184.

[67] Melvin Weinstock, "Citation Indexes," in Encyclopedia of Library and Information Science, V, 19.

Citation-based studies to identify core literature, especially journal literature, date back at least to the 1920's. In 1927, two investigators, Gross and Gross, reported the results of an investigation to determine the chemical journals to which a college library should subscribe.[68] The two based their conclusions upon citation patterns appearing in the Journal of the American Chemical Society. Two years later, a similar study by Allen was reported based upon citations in mathematics. Allen concluded that only a fraction of the available mathematics journals were necessary to satisfy most demands as indicated by sources cited.[69] The same conclusion has been reached by numerous investigators studying other disciplines.

Henkle's study of biochemical literature reported similar findings of core journals for biochemistry. Henkle's study was unique in that he based his investigation upon a statistical analysis of citations appearing in review articles of the Annual Review of Biochemistry.[70]

Twenty-one years after Gross and Gross reported their study, a dissertation by Fussler at the University of Chicago reported the use of citations in an enlarged research study investigating relative importance of various forms of literature--monographs, journals, dissertations, and patents--to chemists and physicists.[71] In addition to assessing the

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[68]B. L. K. Gross and E. M. Gross, "College Libraries and Chemical Education," Science, LXVI (October, 1927), 385-89.

[69]Edward S. Allen, "Periodicals for Mathematicians," Science, LXX (December, 1929), 592-94.

[70]Herman H. Henkle, "Periodical Literature of Biochemistry," MLA Bulletin, XXXVII (December, 1938), 139-47.

[71]Herman H. Fussler, "Characteristics of Research Literature Used by Chemists and Physicists in the United States" (unpublished Ph.D. dissertation, University of Chicago, 1948).

relative importance of various forms of literature, Fussler provided an analysis through time of the changes that had occurred, an estimate of the "life" of materials within the two disciplines, and a breakdown by country of origin of materials. From his investigation, Fussler concludes that dissertations for the two disciplines studied form a secondary source of materials for authors preparing journal articles.

The Fussler study remains a milestone in the application of citation analysis to literature study. The enduring quality of the work is attested to by frequent references found in current literature and the number of investigations into other literatures modeled after it.

Following Fussler's study, there have been eight dissertations completed, and others are either underway or planned, which have utilized many of the procedures and techniques first collectively employed by Fussler. The dissertations completed cover eight fields: U.S. history,[72] botany,[73] geology,[74] fine arts,[75] chemistry in the Soviet Union,[76] public

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[72]Arthur M. McAnally, "Characteristics of Materials Used in Research in United States History" (unpublished Ph.D. dissertation, University of Chicago, 1951).

[73]Carl William Hintz, "Internationalism and Scholarship: A Comparative Study of the Research Literature Used by American, British, French, and German Botanists" (unpublished Ph.D. dissertation, University of Chicago, 1952).

[74]Maria Lao Sunthara, "Some Bibliographical Characteristics of Serial Literature in the Field of Geology" (unpublished Ed.D. dissertation, Indiana University, 1956).

[75]Wesley Clark Simonton, "Characteristics of the Research Literature of the Fine Arts During the Period 1948-1957" (unpublished Ph.D. dissertation, University of Illinois, 1960).

[76]Dale Lockard Barker, "Characteristics of the Scientific Literature Cited by Chemists of the Soviet Union" (unpublished Ph.D. dissertation, University of Illinois, 1966).

administration,[77] agricultural economics,[78] and microbiology.[79] A dissertation is underway to analyze the literature of library science using citation-based procedures.[80]

Kanasy in his dissertation synthesizes literature characteristics of the disciplines investigated in the nine dissertations. A table from his dissertation is produced below. Data from the table suggest that dissertations are a peripheral form of literature in the disciplines studied.

A cross-disciplinary investigation using citation analysis was completed by Brown in assessing the characteristics of scientific serials in mathematics, physics, chemistry, geology, physiology, botany, zoology, and entomology.[81] Brown combined the results in the production of a list of most frequently cited serials and, from this list, it is possible to observe the cross-disciplinary use of serials.[82]

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[77]Navanitaya Intrama, "Some Characteristics of the Literature of Public Administration" (unpublished Ph.D. dissertation, Indiana University, 1968).

[78]Isaac Thomas Littleton, "The Bibliographic Organization and Use of the Literature of Agricultural Economics" (unpublished Ph.D. dissertation, University of Illinois, 1968).

[79]James Emery Kanasy, "Citation Characteristics and Bibliographic Control of the Literature of Microbiology" (unpublished Ph.D. dissertation, University of Pittsburgh, 1971).

[80]William Brace, "A Citation Analysis of Dissertations in Library and Information Science (1960-1970) to Identify a Core Literature as It Is Related to the Curriculum" (Ph.D. dissertation, Case-Western Reserve University, in progress, 1972).

[81]Charles Harvey Brown, Scientific Serials: Characteristics and Lists of Most Cited Publications in Mathematics, Physics, Chemistry, Geology, Physiology, Botany, Zoology, and Entomology. ACRL Monograph No. 16. (Chicago: Association of College and Reference Libraries, 1956).

[82]Ibid., pp. 143-54.

TABLE 1

DISTRIBUTION OF THE LITERATURE OF SELECTED SUBJECTS BY FORM OF PUBLICATION

Subject	Author of Study	Serial References	Non-Serial References			
			Monographs	Documents	Dissertations	Patents
Botany	Hintz	85.8	14.1	-	-	-
Chemistry	Fussler	92.1	7.0	-	-	1.1
Chemistry (USSR)	Barker	86.1	10.0	-	.9	3.0
Geology	Laosunthara	82.9	11.3	-	.8	.2
Microbiology	Kanasy	93.1	5.0	-	.3	-
Physics	Fussler	92.2	6.2	-	-	.1
Agricultural Economics	Littleton	31.4	30.4	3.0	1.4	-
History (U.S.)	McAnally	9.2	45.6	12.7	-	-
Public Administration	Intrama	25.0	56.7	15.1	1.0	-
Fine Arts	Simonton	28.6*	71.4*	-	-	-

*Composite of six fields within Fine Arts

Source: Kanasy, op.cit., p. 114.

While much knowledge has been accrued through citation-based investigations, with the aid of citation indexes the potential gain is even greater.

Citation indexing has been an integral part of the judicial system in the United States since 1873. In that year, Shepard's Citations was first published to aid the lawyer in determining whether the case upon which his present case is to be argued has been modified in some manner, overruled, reversed, limited, or even reaffirmed.

The application of citation indexing to other literatures is of more recent origin. The heavy emphasis upon serial literature in the sciences produced an hospitable environment in which citation indexing, once initiated, has flourished and grown rapidly. The data presented below illustrates the rapid increase of coverage as well as the rapid growth in the number of citations indexed. In view of the preponderance of formal communication in science which appears in journals, the value and inclusive coverage of SCI is readily apparent.

With the aid of data secured from SCI, researchers were able to initiate a second primary thrust of studies based upon citation analysis, examinations of quality and influence of authors' works.

Margolis reports on efforts to apply a quantitative analysis to citations in the determination of a paper's influence upon later works. In the application, Margolis bases his argument upon data derived by Price concerning the number of times papers are cited, reasoning that lesser papers receive fewer citations. In his conclusions, Margolis acknowledges that, "Evaluation by means of citation patterns can be successful only insofar as published papers and their bibliographies reflect scientific

TABLE 2
SCIENCE CITATION INDEX® 1964–1970
COMPARATIVE STATISTICAL SUMMARY

								PERCENT INCREASE (DECREASE) 1970 COMPARED TO					
	1964	1965	1966	1967	1968	1969	1970	1969	1968	1967	1966	1965	1964
Source Journals	700	1,146	1,573	1,711	1,968	2,180	2,192	1	12	28	40	92	214
Source Journal Issues	5,497	9,432	12,444	13,815	15,911	17,761	17,992	1	13	30	45	91	227
Source Journal Items	151,639	235,801	273,870	304,099	308,536	341,430	361,875	6	17	19	32	53	139
Anonymous Source Journal Items	9,500	14,500	13,161	15,033	8,095	13,033	11,320	(15)	40	(33)	(16)	(28)	19
Citations to Journal Items	1,424,947	2,144,103	2,383,084	2,632,872	2,902,358	3,067,384	3,231,992	5	11	23	36	51	127
Citations to Patents	11,575	208,240	10,826	14,444	15,570	15,485	11,425	(26)	(26)	(21)	5	(95)	(1)
Citations to Other Non-Journal Items	353,231	572,597	680,096	739,823	780,787	766,846	864,530	11	11	17	27	51	145
Total Citations from Source Journal Items	1,789,753	2,924,940	3,074,006	3,387,139	3,698,715	3,849,715	4,107,947	6	11	21	34	40	130
Citations to Authored Items*	1,742,896	2,663,806	3,014,737	3,319,546	3,626,027	3,777,272	4,041,165	7	11	22	34	52	132
Citations to Anonymous Items	35,282	52,894	48,443	53,149	57,118	56,958	55,357	(3)	(3)	4	14	5	57
Unique Authored Items Cited*	1,092,384	1,616,987	1,820,877	1,994,120	2,138,526	2,261,839	2,340,128	3	9	17	29	45	114
Citations per Authored Items Cited	1.60	1.65	1.65	1.66	1.67	1.67	1.73	3	4	4	5	5	8
Unique Reference Authors Cited*	323,889	438,915	473,658	510,113	546,567	601,410	619,872	3	13	22	31	41	91
Average Citations per Cited Author	5.40	6.08	6.36	6.50	6.64	6.28	6.52	4	(2)	0	3	7	21

* excepting Patents

Source: Science Citation Index. Source Index. January--March, 1971, [16].

activity and nothing else."[83] An analogy might be made between the complexity of reasons why communication takes place as described earlier in this chapter and the complexity of reasons why citations are employed. These limitations implied are underlined by May in a letter in Science in 1967 on the "Abuses of Citation Indexing," when he observes:

> The deviation [in uses of citations] results from memory failures, lack of self awareness, carelessness, plagiarism of other people's citations without having actually used them, the widespread custom of not citing "obvious" sources, and many other causes--all consequences of the simple fact that the author selects citations to serve his scientific, political, and personal goals. . . .[84] (emphasis added)

A recent effort to evaluate research productivity using publications and citations was applied to university physics departments.[85] The application is an extension of the principle of individual evaluation and opens yet another vista in citation-based studies using SCI as a source of data heretofore so dispersed that broad-based citation studies were economically unattractive.

A second movement in the application of citation studies is typified by the investigation of de Solla Price reported in Science.[86] In examining the interrelatedness of bibliographic citations, Price

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[83]J. Margolis, "Citation Indexing and Evaluation of Scientific Papers," Science, CLV (March, 1967), 1218.

[84]K. O. May, "Abuses of Citation Indexing," Science, CLVI (May, 1967), 890.

[85]Donald Lloyd Spalinger, "The Evaluation of Research Productivity Using Publications and Citations, Applied to University Physics Departments" (unpublished M.B.A. thesis, The University of Texas at Austin, 1971).

[86]Derek J. de Solla Price, "Networks of Scientific Papers," Science, CIL (July, 1965), 510-15.

concludes that a research front of a discipline may be identified by the unique reference patterns in its literature.

The above examples of citation-based studies have been given to illustrate the versatility of the citation as a research tool and its widespread use, in time and in various disciplines. Unrealized potential yet exists in applications of the process; however, the admonition of Bayer and Folger is a cogent one, both for investigators and those reviewing the results of such investigations. "It [SCI] makes feasible the use of citation counts in low budget studies, but as this pilot study suggests, the research problems associated with adequate criterion measures for anything as complex as a professional career are very formidable."[87] Likewise, in reviewing and analyzing other phenomena, the complexity of the process under scrutiny must not be minimized. Publications, communication, and citations result from a myriad of impetuses--no two likely result from the same combination.

Summary

Throughout history, the doctorate has been the mark of distinguished achievement in the acquisition of knowledge. The emphasis on research in the degree program, established as an inherent part of the program years before the degree was brought to America, continues to be its essence as extracts cited above from bulletins of universities throughout the country attest. The degree remains a research degree despite often widespread, vehement

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[87]Alan E. Bayer and John Folger, "Some Correlates of a Citation Measure of Productivity in Science," Sociology of Education, XXXIX (Fall, 1966), 381-90.

denunciations of its suitability in meeting the needs of the nation, especially the training of college and university faculty.

The dissertation, often the first visible product of the process, is the capstone of the degree. As a vehicle to disseminate the results of research undertaken as a part of the doctoral program, it forms an integral part of the process in fulfilling the requirement that research is not complete until the results are disseminated.

As a form of literature, the dissertation is set apart. As a unique form of literature, dissertations are abstracted in Dissertation Abstracts, acquired by research libraries in quantities vastly overshadowed by other monographic acquisitions, and represent a miniscule percentage of literature cited. Yet, dissertations, contributions to knowledge, are being produced at a current rate of 33,700 annually in the United States alone.

Apart from two studies, McPhie and Berelson, the dissertation is seldom more than an incidental part of research efforts in education or communication. Few data about the dissertation have been accrued which may be used to assess its effectiveness in disseminating research results, research that is costly in money and time, affecting nearly all segments of the nation.

Citations and citation indexing are two tools which have been employed extensively in examinations of literatures to identify core materials (especially journals), to map the diffusion and assimilation of ideas, to assess quality and influence of papers and individuals, and to identify networks of individuals.

Communication among individuals takes place for a myriad of

complex reasons. By analogy, authors cite other authors for myriad and complex reasons, often subtle and even unintentional.

The remaining chapters of this paper discuss the application of citations and citation indexing in an investigation to analyze the extent to which the dissertation serves as an information source. The two were utilized to discover and describe diffusion and assimilation patterns of dissertation contents among and within the four disciplines of botany, chemical engineering, chemistry, and psychology.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

The investigation reported here is an exploratory study of scientific information flow. The focus of the investigation is limited to the dissertation as an information source.

Based upon the literature reviewed in the previous chapter, data were collected and analyzed to provide tentative answers to the following questions:

To what extent do dissertations serve as information sources?

What are the characteristics of diffusion patterns of dissertation contents?

What are the characteristics of assimilation patterns of dissertation contents?

These same questions provided broad guidelines for the design of the inquiry.

Investigation design

In the design of the investigation, the absence of available empirical data about dissertations as information sources forced the study into an exploratory mode. The study was designed to yield data about the characteristics of diffusion and assimilation upon which inferences and hypotheses might be drawn. The inferences and hypotheses derived might then later serve as base-points for further inquiry in search of generalizable characteristics of dissertations as information sources.

Data derived from empirical studies reviewed in the previous chapter clearly indicate that dissertations as a form of literature represent a miniscule percentage of cited literature in disciplines as diverse as chemistry, agricultural economics, and public administration. Similarly, data concerning acquisition rates of dissertations suggest that dissertations represent an even more miniscule percentage of materials acquired by research libraries (and by extension, probably no more than a negligible percentage in other libraries).

Unanswered by the two foregoing statements, however, is the question, "To what extent do dissertations serve as information sources?" in the dissemination of scientific research completed during the doctoral program. To assess the extent, the investigation was designed to map two facets of the total dissemination process: (1) diffusion of dissertation contents in open literature and (2) the assimilation of dissertation contents as indicated by citations to the dissertation.

It was recognized in the design of the study that diffusion of dissertation contents occurs in both formal and informal settings. For the purposes of this study, the focus was limited to the formal communications process. In mapping the diffusion patterns in open literature, attention was directed to materials based primarily upon dissertations which were published and distributed through normal trade channels. Such materials appeared in formats of a journal article, a section or chapter in a book, or an entire book.

Excluded from the process was the diffusion which occurred through informal exchange processes--oral communications in seminars, conferences, symposia, interpersonal communication, and closed literature,

preprints, reprints, and technical reports. The exclusion was based upon the lack of open, free, and equal access of all individuals to the processes, a problem well articulated by Pasternack in his review of informal information exchange groups.[1] For this reason, analysis of data accrued in the investigation reported in this paper must necessarily be reported as a part of the communications process, not its totality. Likewise, in formulating recommendations for further study and action in light of data gathered in the investigation, the formal communications process, the focus of the investigation, must be viewed as one part, possibly even the less important one.

The assimilation patterns of dissertation contents from the dissertation itself were constructed through utilization of SCI to locate citations to dissertations included within the investigation.

Selection of disciplines for the study

For this investigation, a set of disciplines was selected to permit comparison and contrast of diffusion and assimilation patterns. In the absence of available empirical data, it was assumed that disciplines of diverse nature would yield a greater range of variations in diffusion and assimilation patterns than would disciplines with many similarities. The degree of freedom in choosing disciplines of diverse nature was constrained by one of the tools, SCI, used in the investigation. Choice of disciplines was necessarily limited to disciplines covered by SCI, inasmuch as SCI served as the source of citations to dissertations studied.

Within the constraint imposed by SCI, a representative discipline from each broad division of science was selected for study: from applied

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[1]Pasternack, op. cit.

science, chemical engineering; from behavioral science, psychology; from life science, botany; and from physical science, chemistry.

Chemistry and chemical engineering were chosen for the common foundation upon which each rests, coupled with the pure science aspect of the former and the applied science aspect of the latter. As one of the most intensively studied literatures, chemistry is represented by a vast amount of empirical data concerning communication of information within the discipline, underlining the literature-dependent operations of chemistry.

The choice of psychology represented the inclusion of a "soft" science as contrasted with chemistry or botany. Botany was included on the basis of previous inquiries which suggest that botanical literature has a longer "life" than do many literatures of the sciences.

Selection of dissertations for the study

The choice of dissertations to be investigated was based upon the same primary criterion as the selection of disciplines, diversity, and was subject to similar constraints.

To introduce diversity, dissertations from more than one institution were studied. On the basis of data presented in A Rating of Graduate Programs (Roose and Andersen)[2] three universities were selected whose departments of botany, chemical engineering, chemistry, and psychology ranked in the same relative order one to another on both scales presented in the report: (1) quality of graduate faculty and (2)

[2]Kenneth D. Roose and Charles J. Andersen, A Rating of Graduate Programs (Washington, D.C.: American Council on Education, 1970).

effectiveness of doctoral program.

Of the possible institutions meeting the criterion, the factors of geographical dispersion and cooperation with Dissertation Abstracts in reporting dissertations accepted were used to narrow the selection to the University of California, Berkeley; Pennsylvania State University; and The University of Texas at Austin. Of the twelve departments invited to participate in the study, eleven accepted and supplied data about the department's graduates required to undertake the study.

In choosing which dissertations to study among those produced at each institution within disciplines chosen, the availability of data in SCI imposed constraints upon the extent of retrospective inquiry possible. Similarly, dissertations produced recently have not yet been mined for subsequent publications or cited in literature indexed by SCI.

For these reasons, the period chosen for the investigation was 1963 to 1967. The period generally coincides with the base period for the Roose and Andersen study and the coverage of SCI.

Excluded from the study were those dissertations whose authors reside in countries other than the United States. The exclusion was based upon the assumption that variations of patterns of diffusion and assimilation may exist by country. All other dissertation authors at each institution for whom addresses were supplied were asked to participate in the study.

Data collection

Data for the investigation were gathered from two principal sources: (1) the author of each dissertation included within the study and (2) SCI. Each dissertation author was asked to supply bibliographic

citations to materials published which were based primarily upon the dissertation and to identify each author who had cited the dissertation. Citations to dissertations included in the study were extracted from a six-year period of SCI.

Questionnaire development and distribution

In order to collect data from the dissertation authors, a questionnaire (See Appendix) was developed and pretested on forty-three faculty members at The University of Texas at Austin. The forty-three represented more than thirty institutions awarding the doctorate. The pretest was run to test the intelligibility of the questionnaire and for the purpose of assessing the feasibility of the research proposal.

Following minor modifications of the form suggested during the pretest, the questionnaire was sent to each dissertation author identified by the departments. For those individuals whose dissertation had not been cited in journals indexed in SCI, the questionnaire consisted of a single page; for those whose dissertation had been cited, a second page was added. For those authors not responding to the questionnaire within a month, a second one was sent with a follow-up letter. The response rates are included in the discussion of the data collected.

Data analysis

Data for the study consisted of citations of works published based on the dissertation, citations to dissertations studied, identification of relationships between citing author and cited dissertation author, and information about the dissertation author. From these data, descriptions of patterns of diffusion and assimilation of dissertation

contents were drawn and analyzed. An account of the data gathered and their analysis are presented in the next chapter.

CHAPTER IV

DISCUSSION OF RESULTS: CHARACTERISTICS OF THE DISSERTATION AS AN INFORMATION SOURCE

Answers were sought to a number of questions concerning the extent to which dissertations serve as information sources. Among questions explored in the investigation were the following:

To what extent do dissertations serve as sources of information for publications?

What are the characteristics of these publications--authorship, form, source, time lag, quantity?

Do patterns of diffusion differ by discipline? Within disciplines? Among institutions?

What are the discernible patterns of assimilation of dissertation contents as reflected by citations to dissertations?

What are the the characteristics of the assimilation patterns?

Do patterns of assimilation differ by discipline?

Throughout the investigation, the underlying assumption was that the dissertation is a vehicle for the dissemination of results of research undertaken during candidacy for the doctorate. By definition, each dissertation represents a contribution to knowledge, a scholarly, refereed, and validated monograph. If research is incomplete until the results are disseminated (as suggested by the SATCOM Report and the President's Science Advisory Committee), then the role of the dissertation is a vital one in the research process of graduate education.

For the foregoing reasons, the identification of the extent to which dissertations serve as information sources and the differences among and within disciplines, if any, are necessary requisites to an evaluation of the extent to which the dissertation fulfills its assigned role.

The presentation and analysis of data in Chapter IV are divided into two major parts--the diffusion of dissertation contents and the assimilation of dissertation contents as indicated by citations to the dissertation.

The presentation within each part generally follows a pattern of first examining the data clumped, that is, a macro view, and then the data distributed, a micro view. This procedure permits the identification of similarities and dissimilarities among and within disciplines and among institutional sources of the doctorate.

The data presented in the chapter were supplied by dissertation authors from three universities: The University of California, Berkeley, Pennsylvania State University, and The University of Texas at Austin (hereinafter referred to as Berkeley, Penn State, and Texas)--who graduated during the period 1963 to 1967 and citations were taken from SCI, 1965-70. Data from dissertation authors were elicited by questionnaire with response rates ranging from 60 to 90 percent.[1] Departmental response rates to the

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[1]Response rates to the questionnaire were calculated by dividing the number of completed questionnaires by the number of questionnaires believed to have reached dissertation authors. In using addresses supplied by departments, some questionnaires were returned by the Post Office as not forwardable. The number of questionnaires believed to have reached dissertation authors is the total number of questionnaires sent, less the number returned by the Post Office.

questionnaire were as follows:

Botany: Berkeley, 87 percent; Penn State, 60 percent; and Texas, 88 percent.
Chemical engineering: Berkeley, 77 percent; Penn State, 90 percent; and Texas, 78 percent.
Chemistry: Berkeley, 75 percent and Texas, 77 percent.[2]
Psychology: Berkeley, 73 percent; Penn State, 70 percent; and Texas, 74 percent.

Diffusion of dissertation contents

The data presented are based upon the responses of 441 dissertation authors to the question, "Have you authored or co-authored any published journal articles, abstracts, books, or parts of books, i.e., chapters or sections, which were based primarily upon your dissertation?"[3]

Publications based upon the dissertation

Data in Table 3 show that 29 percent of the dissertation authors

TABLE 3

NUMBER AND PERCENT OF DISSERTATIONS STUDIED YIELDING/NOT YIELDING PUBLICATIONS

Dissertations	Number	Percent
Yielding publications	312	71
Not yielding publications	129	29

[2]Doctoral recipients in chemistry from Penn State did not participate in the study.

[3]The underlined phrase "based primarily upon your dissertation" was interpreted as excluding materials reporting research performed subsequent to the completion of the dissertation.

participating in the investigation reported that they had not produced any publications based primarily upon the dissertation. For nearly one-third of the dissertations studied, the sole source of an extended discussion of the research results reported in the dissertations are the dissertations themselves. Individuals inquiring into the results reported in these dissertations are limited to information contained in various abstracting services for insights into the findings. While abstracts can and do serve as negative selection aids, i.e., data in abstracts may be the basis for exclusion of the document for further interest or examination, abstracts cannot replace full-text documents. Too, the abstract cannot take the place of a dissertation-based publication, for the abstract must necessarily provide less data than the original publication; observe how seldom an abstract is cited by an author as a source of information or data for his current work. Practically speaking, nearly one-third of the research results reported in the dissertations studied is not readily accessible to the inquirer.

As the 29 percent figure is drastically lower than the 66 percent figure cited by McPhie's study (reviewed in Chapter II), do rates among sciences vary and, if so, to what extent? Table 4 presents data based upon a division by discipline. Within the four broad divisions of science--applied, behavioral, life, and physical--represented in the investigation, dissertations served as information sources for publications in frequencies ranging from 48.6 percent in psychology to 88 percent in botany. Even arrayed in this manner, all disciplines studied produced greater percentages of dissertations serving as information sources for subsequent publications than did the social studies education dissertations

TABLE 4

NUMBER AND PERCENT OF DISSERTATIONS STUDIED YIELDING/NOT YIELDING PUBLICATIONS, BY DISCIPLINE

Discipline	Dissertations yielding publications		Dissertations not yielding publications	
	Number	Percent	Number	Percent
Botany	59	88.0	8	12.0
Chemical engineering .	58	86.6	9	13.4
Chemistry	124	77.0	37	23.0
Psychology	71	48.6	75	51.4

(some 33 percent yielded subsequent publications) which McPhie investigated.

Viewing the data from still another vantage point, Table 5 presents statistics based upon institutional source of the doctorate.

TABLE 5

NUMBER AND PERCENT OF DISSERTATIONS STUDIED YIELDING/NOT YIELDING PUBLICATIONS, BY INSTITUTION AWARDING DOCTORATE

Institution	Dissertations yielding publications		Dissertations not yielding publications	
	Number	Percent	Number	Percent
Berkeley	186	74.1	65	25.9
Penn State	17	44.7	21	55.3
Texas	109	71.7	43	28.3

The uniformity of diffusion patterns among institutions studied is greater than the uniformity among disciplines, approximately 30 percent spread by institution compared to approximately 40 percent spread by discipline. Yet, during the period 1963 to 1967 within the sample studied, more than one-quarter of the dissertations produced at Berkeley, whose departments ranked among the top five departments nationally in the Roose and Andersen study, did not reach print in some form (other than in abstracting services) in the open literature; of those dissertations produced at Penn State, more than one-half did not serve as an information source for subsequent publications.

Differences within disciplines are reflected by data in Table 6. Of the four disciplines studied, two, chemistry and psychology, have commonly identified sub-fields which permit further analysis of the data to discover if differences exist at the micro level. From this perspective, sub-fields do differ; however, it is observed that the least exploited segment of dissertations in chemistry, that of physical chemistry, is well above the level of the most exploited segment of psychology dissertations, that of experimental psychology. The greatest difference, however, is noted in the extremes, clinical psychology dissertations and dissertations included under "other" in chemistry. In this instance, the range is greater than 45 percent. Within the discipline, however, it is noted that patterns of the sub-fields do not deviate greatly from the pattern for the parent discipline.

An anomaly not treated in the data of Table 6 is the fact that nearly all of the dissertations listed under "nuclear chemistry" were disseminated through informal channels in the format of technical reports

TABLE 6

NUMBER AND PERCENT OF DISSERTATIONS STUDIED YIELDING/NOT YIELDING PUBLICATIONS, BY SUB-FIELDS

Subfields[a]	Dissertations yielding publications		Dissertations not yielding publications	
	Number	Percent	Number	Percent
Chemistry	124	77.0	37	23.0
Inorganic	13	76.5	4	23.5
Nuclear[b]	19	82.6	4	17.4
Organic	34	75.6	11	24.4
Physical	40	72.7	15	27.3
Other[c]	18	85.7	3	14.3
Psychology	71	48.6	75	51.4
General	17	39.5	26	60.5
Clinical	14	40.0	21	60.0
Experimental	30	58.8	21	41.2
Social and industrial	8	57.1	6	42.9

[a]Classification data for dissertations were taken from Dissertation Abstracts.

[b]Includes those dissertations classified under "solid state physics" and "nuclear physics" by Dissertation Abstracts.

[c]Includes dissertations not elsewhere classified, e.g., "general" and "pharmaceutical chemistry."

issued by the University of California Radiation Laboratory. Contrast this extensive informal dissemination process and the 82.6 percent publication level with those disciplines and sub-disciplines having no such elaborate informal dissemination process and a high rate of dissertations not yielding publications. In two instances, general and clinical psychology, the rates for dissertations not yielding publications approach the rate

cited by McPhie for social studies education dissertations, 66 percent.

If one accepts the proposition that research is incomplete until the results are disseminated, then the logical conclusion one must reach, in view of the level of acquisitions of dissertations among research libraries discussed previously, coupled to the data presented in the above tables showing that approximately one-third of the dissertations do not serve as information sources for further publications, is that approximately one-third of the research is not yet complete.

Some of the respondents to the questionnaire included comments on the completed questionnaire. A portion of these comments add insight into possible reasons for non-exploitation of dissertations in subsequent publications. A primary reason for not exploiting the dissertation hinges upon lack of interest. Comments focusing upon lack of sufficient interest can be categorized into two segments: (1) my interests have changed from the area in which I did my dissertation research to another one and (2) I had little interest in the topic--the dissertation was simply a step in the process leading to a doctorate.

Another reason offered is that the dissertation author is not rewarded for producing dissertation-based publications. Rather, rewards come from publication of research currently underway or from additional research completed. Rewards and interest seem to be major factors in the diffusion process.

The remainder of this section of the paper focuses upon the other portion of the dissertations, the two-thirds which served as information sources for published materials. However, a portion of the conclusions and recommendations in the next chapter is devoted to the

non-exploited dissertations, including speculations into additional causes of the apparent short-circuit in the dissemination process.

Authorship of dissertation-based publications

In analyzing patterns of authorship of dissertation-based materials, a repetition of general patterns of yield discussed above was encountered. Variations by discipline cross institutional boundaries while differences by sub-fields appear restricted to a particular institution. The latter are not represented by sufficient data to warrant further examination, e.g., the production of a single author within a sub-field so skewed the data curve for authorship characteristics that further observations or generalizations are unwarranted.

Data presented above indicate that some 70 percent of the dissertations reviewed were the source of materials published in the open literature. An analysis indicates that the contents of 312 dissertations were exploited to produce materials in other formats. Table 7 illustrates the authorship patterns of these materials. To the casual observer, it is surprising to note the distinct cleavage manifest by the authorship data between disciplines on the basis of single and multiple authorship in view of the trend toward multiple authorship described by Price.[4] The presence of individually authored papers in percentages as great as those in botany and psychology suggest that fields, sub-fields, or portions of publications within fields may not exhibit the characteristic

[4]Derek J. de Solla Price, Little Science, Big Science (New York: Columbia University Press, 1963), pp. 86-91.

of multiple authorship to the degree that Price implies.[5]

Within the category of publications produced through multiple authorship, there are two distinct sub-categories: (1) publications in which the dissertation author is the lead author and (2) publications in which the lead author is another person, often a doctoral student colleague or the dissertation supervisor. Table 8 presents data describing lead authorship patterns of dissertation-based publications. Data for the Table were extracted from bibliographic references supplied by dissertation authors. Instances were encountered in which four lead authors

TABLE 7

AUTHORSHIP CHARACTERISTICS OF DISSERTATION-BASED PUBLICATIONS STUDIED, BY DISCIPLINE

Discipline	Single authorship		Multiple authorship	
	Number	Percent	Number	Percent
Botany	77	64.7	42	35.3
Chemical engineering	4	3.1	126	96.9
Chemistry	12	4.2	276	95.8
Psychology	75	78.9	20	21.1

were coupled to materials based upon a single dissertation. Such practices make difficult the location of material which a dissertation author prepares for the open literature. Likewise, locating dissertation-based materials

[5]Exceptions to Price's conclusion of scientific papers showing trends toward multiple authorship have been stated by others, e.g., Beverly L. Clark, "Multiple Authorship Trends in Scientific Papers," Science CXLVII (May, 1964), 822-24.

TABLE 8

NUMBER AND PERCENT OF DISSERTATION-BASED PUBLICATIONS APPEARING/NOT APPEARING WITH DISSERTATION AUTHOR AS LEAD AUTHOR, BY DISCIPLINE

Discipline	Lead author and dissertation author			
	Same person		Different person	
	Number	Percent	Number	Percent
Botany	33	78.6	9	21.4
Chemical engineering	100	79.4	26	20.6
Chemistry	165	59.8	111	40.2
Psychology	19	95.0	1	5.0

by individuals who publish materials as a secondary author through citation indexes is virtually impossible without recourse to other detection aids.

Variations among institutions and within disciplines were not great enough to warrant analysis of authorship characteristics beyond those presented in Tables 7 and 8.

Viewing authorship data presented in Tables 7 and 8 from still another perspective, the homogeneity of patterns within disciplines becomes apparent when the data are clumped to illustrate percentages of materials produced in each discipline appearing under the dissertation author's name: psychology, 98.1 percent; chemical engineering, 92.4

percent; botany, 80 percent; and chemistry, 61.5 percent.[6]

Among the dissertation-based psychology publications, there is practically no deviation from the practice of the dissertation author being lead author. Part of the high percentage is explained by a 75 percent rate of single authorship (Table 7); however, chemical engineering with a 4 percent rate for single authorship of dissertation-based materials produces more than 90 percent of its dissertation-based publications with the lead author the same as the dissertation author. At the other end of the continuum is chemistry with more than one-third of dissertation-based publications appearing under a name other than the name of the author of the dissertation upon which the material is based.

Quantity of dissertation-based publications produced

From previous tables, diffusion patterns begin to take form. Table 3 illustrates that some 70 percent of the dissertations studied served as information sources for other publications appearing in the open literature. Table 7 provides data which show that the 441 dissertations studied yielded 632 publications. Data in Table 9 below show the number of publications produced for each dissertation. The range of materials produced is 8 with a mean of 2.03 articles for dissertations yielding publications and a mean of 1.43 articles for all 441 dissertations

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[6]Some insight into departmental preference at the University of California, Berkeley is offered in David W. Breneman, The Ph.D. Degree at Berkeley: Interviews, Placement, and Recommendations, Paper P-17 (Berkeley, Calif.: Office of the Vice President--Planning and Analysis, University of California, 1971), p. 30, in which comments upon the different publishing practices of graduate students within the Departments of Botany and Chemistry are reported. Similar discipline preferences may account for the wide range of practices noted in Tables 7 and 8.

TABLE 9

QUANTITY AND PERCENT OF PUBLICATIONS PRODUCED BASED UPON 441 DISSERTATIONS STUDIED

Quantity of publications produced based primarily upon the dissertation	Dissertations	
	Number	Percent[a]
0	129	29.2
1	133	30.2
2	97	22.0
3	43	9.8
4	26	5.9
5	9	2.0
6	2	.4
7	1	.2
8	1	.2

[a]Column does not total 100 percent due to rounding.

studied. While the two means are accurate representations of data supplied by dissertation authors participating in the study, both means, especially the former, are misleading in one respect if not accompanied by the percentage of dissertations which yielded no subsequent materials published in the open literature.

Viewing these same data from another vantage point, the dissertations when grouped by discipline reflect diffusion patterns contained in Table 10. Richness, that is, number of publications per dissertation,

TABLE 10

QUANTITY AND PERCENT OF DISSERTATION-BASED MATERIALS PUBLISHED, BY DISCIPLINE

Quantity of dissertation-based materials published per dissertation	Discipline							
	Botany		Chemical eng.		Chemistry		Psychology	
	No.	Per-cent	No.	Per-cent	No.	Per-cent	No.	Per-cent
0	8	11.9	9	13.4	37	23.0	75	51.4
1	23	34.3	20	29.8	41	25.5	49	33.6
2	21	31.3	19	28.4	37	23.0	20	13.7
3	10	14.9	9	13.4	22	13.7	2	1.4
4	2	3.0	6	9.0	18	11.2	-	--
5	2	3.0	3	4.5	4	2.5	-	--
6	1	1.5	1	1.5	-	--	-	--
7	-	--	-	--	1	.6	-	--
8	-	--	-	--	1	.6	-	--

Columns may not add to 100 percent due to rounding.

ranges from 2.3 publications for each dissertation in chemistry to 1.3 publications in psychology. Data in Table 10 are transposed to provide mean number of publications shown in Table 11. Data in Tables 10 and 11 reveal a pattern-similarity among botany, chemical engineering, and chemistry for patterns of diffusion but a dissimilar one for psychology. Coupled to data presented in Table 4, indicating that less than one-half of psychology dissertations yielded published materials, are now data from Tables 10 and 11 which show that psychology has a low mean publication

TABLE 11

MEAN NUMBER OF PUBLICATIONS BASED UPON DISSERTATIONS YIELDING PUBLICATIONS/ALL DISSERTATIONS STUDIED, BY DISCIPLINE

Discipline	Mean number of publications
Botany	
All dissertations	1.8
Dissertations yielding publications	2.0
Chemical engineering	
All dissertations	1.9
Dissertations yielding publications	2.2
Chemistry	
All dissertations	1.8
Dissertations yielding publications	2.3
Psychology	
All dissertations	.6
Dissertations yielding publications	1.3

rate of dissertation-based material and a pattern in which the majority of dissertations yield only a single publication. Table 11 presents data which indicate that psychology is the only discipline studied whose mean for all dissertations examined falls below 1.0. Too, both means for psychology are nearly one full publication below those of the other three disciplines.

Turning to a realignment of data by institutional source of the doctorate, Table 12 contains data suggesting that the quantity of publications produced from a dissertation may be partially a product of institutional influence. Data in Table 12 indicate a similarity between the patterns for Berkeley and Texas; however, the pattern for Penn State is a dissimilar one with a range substantially smaller and a heavy concentration of single publications.

TABLE 12

QUANTITY AND PERCENT OF DISSERTATION-BASED MATERIALS PUBLISHED, BY INSTITUTIONAL SOURCE OF DOCTORATE

Quantity of dissertation-based materials published per dissertation	Institution					
	California		Penn State		Texas	
	No.	Percent	No.	Percent	No.	Percent
0	65	25.9	21	55.3	43	28.3
1	69	27.5	12	31.6	52	34.2
2	60	23.9	5	13.2	32	21.0
3	27	10.8	-	—	16	10.5
4	22	8.8	-	—	4	2.6
5	6	2.4	-	—	3	2.0
6	1	.4	-	—	1	.6
7	-	—	-	—	1	.6
8	1	.4	-	—	-	—

Columns may not total 100 percent due to rounding.

Data from Tables 5 and 12 suggest that differences exist by institutional source of the doctorate; however, the differences are less pronounced than differences among disciplines. Table 13 lists mean dissertation-based publication rates for the three institutions. Penn State exhibits pattern characteristics dissimilar to Berkeley and Texas. Penn State is the only one to fall below 1.0 publication per dissertation and Penn State's mean publication rate based only upon dissertations yielding publications is below the all inclusive mean for either Berkeley

TABLE 13

MEAN NUMBER OF PUBLICATIONS BASED UPON DISSERTATIONS YIELDING PUBLICATIONS/ ALL DISSERTATIONS STUDIED, BY INSTITUTION

Institution	Mean number of publications
Berkeley	
All dissertations	1.6
Dissertations yielding publications	2.1
Penn State	
All dissertations	.6
Dissertations yielding publications	1.3
Texas	
All dissertations	1.4
Dissertations yielding publications	1.9

or Texas. The diffusion pattern appears to be a cumulative one, reflecting a lower yield per dissertation, Table 13; a concentration in the single publication category, Table 12; and a lower percentage of dissertations exploited for subsequent publications, Table 5. An expansion of this pattern to include time differential of publication appearance will be noted below. Conversely, the pattern for Berkeley exhibits opposite characteristics, e.g., high mean publication rate, high percentage of dissertations exploited.

As can be deduced from Table 6, variations within disciplines do exist; however, the paucity of data at the micro level accrued in this investigation does not warrant intensive analysis due to extreme fluctuations caused often by a single member of a set. Generally, further analysis indicates that sub-field patterns approximate those of the parent discipline and aberrations likely result from departmental idiosyncracies described in the title by Breneman cited above.

Time differential of dissertation-based publications

To discuss time lag of dissertation-based publications would misrepresent actual practice in which such publications often appear in advance of the dissertation. A more descriptive and inclusive phrase for the focus of this section of the paper is "time differential." In view of the quantity and percentage of dissertation-based materials published over a period of time extending in both directions beyond the period from which the dissertations were drawn, it is important to assess this time differential in order to gain insights into the rapidity and the duration of the diffusion process of dissertation contents in the open literature.

Table 14 exhibits data for all dissertations studied yielding materials. In spite of examples of publications six years before and seven years after the dissertation was accepted, the small percentage of materials at either extreme suggests that a majority of materials published fall within a period one year prior to three years after the dissertation's acceptance. Viewed as a cumulative process, by the end of the third year following completion of the dissertation, nearly 90 percent of the materials had been published. In view of the lag in scientific and technical publishing, seemingly most production of such materials based upon dissertations was completed by the second year following completion of the dissertation. Exceptions to this observation are revealed in Table 15, which presents the data for the time differential arranged by discipline.

In Table 15, differences among disciplines are emphasized in the cumulative percentage columns. These same cumulative percentage

TABLE 14

TIME DIFFERENTIAL OF DISSERTATION-BASED PUBLICATIONS FOR 312 DISSERTATIONS STUDIED

Year during which publication appeared in respect to completion of dissertation	Number	Percent	Cumulative Percent[a]
-3 or more	10	1.6	1.6
-2	25	4.0	5.6
-1	67	10.6	16.2
0	126	19.9	36.1
1	162	25.6	61.7
2	114	18.0	79.7
3	59	9.3	89.0
4	28	4.4	93.4
5	21	3.3	96.7
6	15	2.4	99.1
7	5	.8	99.9

[a]Column does not total 100 percent due to rounding.

figures are arrayed separately in Figure 1 to portray graphically the differences in diffusion patterns among the four disciplines. In Table 15 and Figure 1, differences are emphasized through the cumulative percentages. Of the four disciplines, chemistry dissertations have yielded 10 percent of the forthcoming materials two or more years before the dissertation is completed. Chemistry maintains a decisive lead until the first year after the dissertation is completed. During that year, chemical engineering surpasses chemistry to become, in the fifth year,

TABLE 15

TIME DIFFERENTIAL OF DISSERTATION-BASED PUBLICATIONS FOR 312 DISSERTATIONS STUDIED, BY DISCIPLINE

Year during which publication appeared in respect to completion of dissertation	Discipline											
	Botany			Chemical eng.			Chemistry			Psychology		
	No.	Percent	Cum. percent	No.	Percent	Cum. percent	No.	Percent	Cum. percent[a]	No.	Percent	Cum. percent
- 3 or more	-	--	--	-	--	--	10	3.5	3.5	-	--	--
- 2	3	2.5	2.5	3	2.3	2.3	19	6.6	10.1	-	--	--
- 1	9	7.6	10.1	8	6.2	8.5	46	16.0	26.1	4	4.2	4.2
0	14	11.8	21.9	32	24.6	33.1	74	25.7	51.8	6	6.3	10.5
1	31	26.0	47.9	54	41.5	74.6	54	18.7	70.5	23	24.2	34.7
2	32	26.9	74.8	23	17.7	92.3	33	11.4	81.9	26	27.4	62.1
3	20	16.8	91.6	4	3.1	95.4	18	6.2	88.1	17	17.9	80.0
4	2	1.7	93.3	5	3.8	99.2	13	4.5	92.6	8	8.4	88.4
5	3	2.5	95.8	1	.8	100.0	12	4.2	96.8	5	5.3	93.7
6	5	4.2	100.0				6	2.1	98.9	4	4.2	97.9
7							3	1.0	99.9	2	2.1	100.0

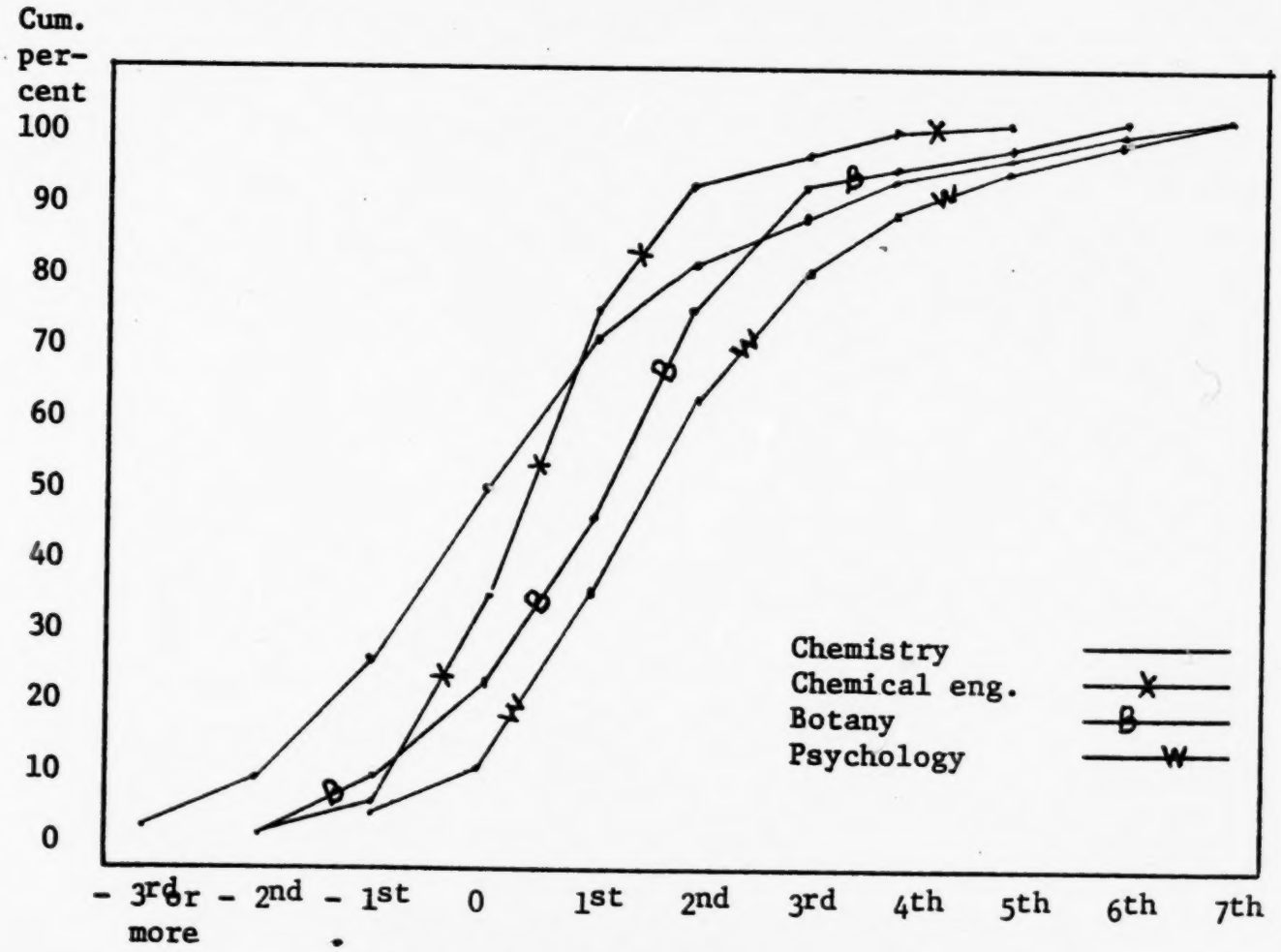
[a]Column does not total 100 percent due to rounding.

the first discipline to exhaust the dissertation as a source for publications.

Conversely, psychology dissertations have yielded slightly more than one third of the recorded publications by the first year after the dissertation is finished, an extension of the pattern for psychology in which fewer materials are published from a smaller percentage of dissertations.

FIGURE 1

CUMULATIVE APPEARANCE OF DISSERTATION-BASED PUBLICATIONS FOR 312 DISSERTATIONS STUDIED, BY DISCIPLINE



Although indications of the rapidity with which the dissemination process takes place are present in Tables 14 and 15 and again in Figure 1, the variations in actual patterns are obscured by data representing multiple publications from the same dissertation. Table 16 presents data which give a clearer representation of this aspect of the dissemination rate in presenting data about the first publication produced. In comparing the first publication produced with all produced (Table 14),

TABLE 16

TIME DIFFERENTIAL FOR FIRST DISSERTATION-BASED PUBLICATION FOR 312 DISSERTATIONS STUDIED

Year during which first publication appeared in respect to completion of dissertation	First publication		
	Number	Percent	Cumulative percent
- 3 or more	6	1.9	1.9
- 2	18	5.8	7.7
- 1	47	15.1	22.8
0	63	20.2	43.0
1	80	25.6	68.6
2	52	16.7	85.3
3	18	5.8	91.1
4	18	5.8	96.9
5	7	2.2	99.1
6	2	.6	99.7
7	1	.3	100.0

the mean time differential for all publications is 1.2 years after the dissertation was completed while the mean for first publication is .8 years. The cumulative percentage patterns between all publications and first publication are similar, with first publication exhibiting an earlier publication rate as would be expected.

Table 17 presents first-publication data ordered by discipline. The data describe two aspects of the speed of dissertation-content diffusion through other publications: (1) at one extreme, the percentage reported quickly and (2) at the other extreme, the percentage reported some years after the dissertation is completed. The latter aspect is not readily apparent in Table 15, as many of the publications appearing some years after the dissertation was completed were second and third papers, continuations of materials presented previously in a first paper.

Figure 2 illustrates that two disciplines, botany and chemical engineering, produce a higher percentage by the end of the third year than do the other two until the end of the fifth year.

Again in Table 17 and Figure 2, psychology presents a dissimilar pattern, a lagging diffusion pattern for first publication. Contrast the rapidity of diffusion between chemistry and psychology. For chemistry, by the time the dissertation is accepted, some two-thirds of the research has been reported, contrasted with some 11 percent in psychology. The means for the four disciplines for the appearance of first publication (.02 years for chemistry, .9 years for chemical engineering, .9 years for botany, and 2.1 years for psychology) underscore the time lag among dissertation-based publications in psychology, more than 2 years behind chemistry and 1 year behind chemical engineering and botany.

TABLE 17

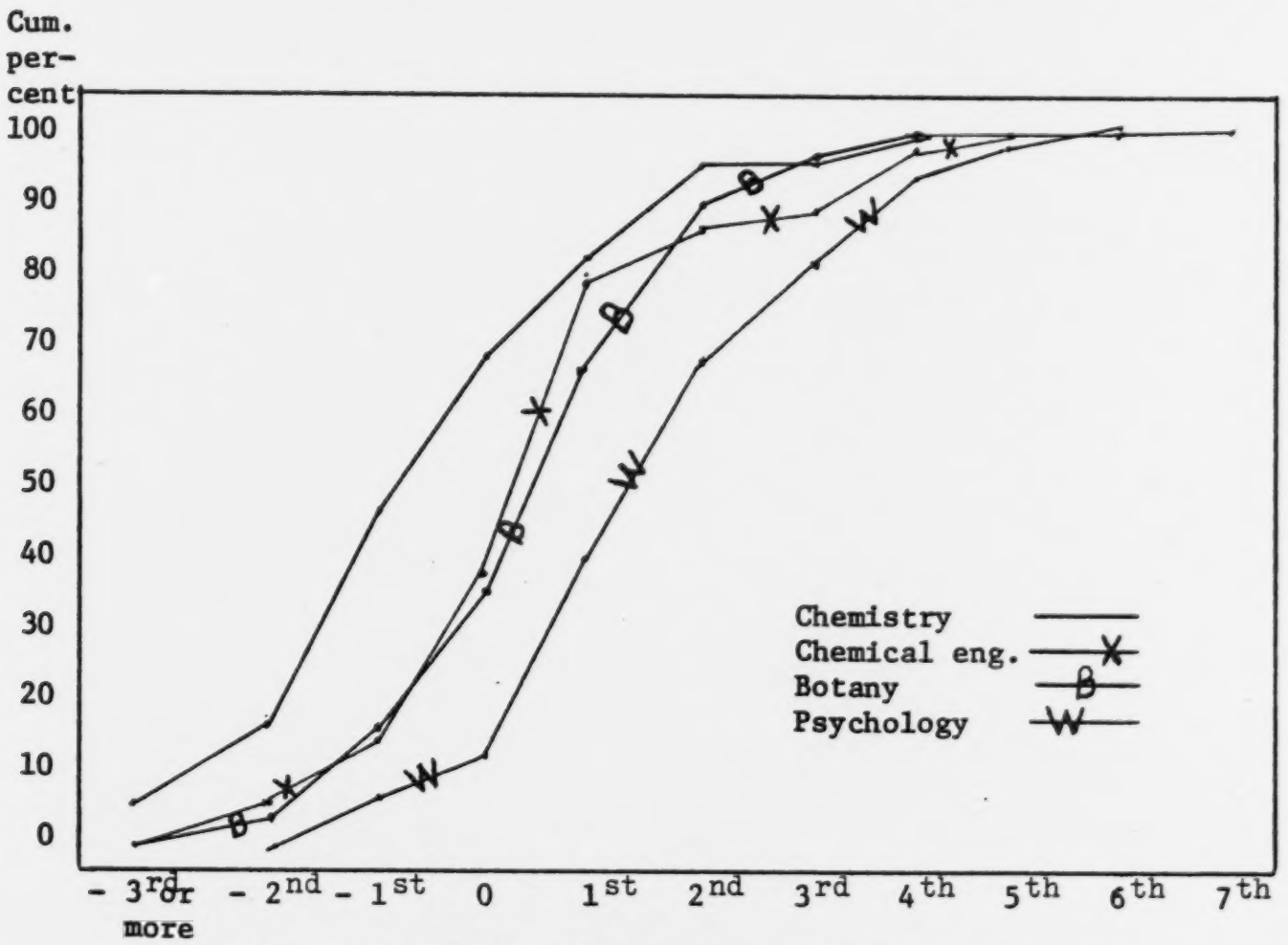
TIME DIFFERENTIAL OF FIRST DISSERTATION-BASED PUBLICATION FOR 312 DISSERTATIONS STUDIED, BY DISCIPLINE

Year in which publication appeared in respect to completion of dissertation	Discipline											
	Botany			Chemical eng.			Chemistry			Psychology		
	No.	Per-cent	Cum. per-cent	No.	Per-cent	Cum. per-cent[a]	No.	Per-cent	Cum. per-cent[a]	No.	Per-cent	Cum. per-cent
- 3 or more	-	--	--	-	--	--	6	4.8	4.8	-	--	--
- 2	2	3.4	3.4	3	5.2	5.2	13	10.5	15.3	-	--	--
- 1	7	11.9	15.3	5	8.6	13.8	31	25.0	45.3	4	5.6	5.6
0	12	20.3	35.6	14	24.1	37.9	33	26.6	66.9	4	5.6	11.2
1	19	32.2	67.8	23	39.6	77.5	18	14.5	81.4	20	28.2	39.4
2	13	22.0	89.8	5	8.6	86.1	15	12.1	93.5	19	26.8	66.2
3	4	6.8	96.6	1	1.7	87.8	2	1.6	95.1	11	15.5	81.7
4	2	3.4	100.0	6	10.3	98.1	2	1.6	96.7	8	11.3	93.0
5				1	1.7	99.8	3	2.4	99.1	3	4.2	97.2
6							-	--	99.1	2	2.8	100.0
7							1	.8	99.9			

[a]Column does not total 100 percent due to rounding.

FIGURE 2

CUMULATIVE APPEARANCE OF FIRST DISSERTATION-BASED PUBLICATION FOR 312 DISSERTATIONS STUDIED, BY DISCIPLINE



Data for first publication when grouped by institution yield a mean for Berkeley of .7 years; for Texas, .8 years; and for Penn State, 1.2 years; a much narrower range than that displayed when the data are grouped by discipline. Likewise, variations within discipline do exist, e.g., the mean for psychology for Penn State is 1.1 years; for Berkeley, 2.1 years; and for Texas, 2.3 years; an instance in which patterns are reversed. Most variations are minor and no further purpose is served in reviewing the results of the analysis.

One more aspect of diffusion rates is presented before mention is made of sources and forms of publications. Table 18 presents the means for appearance of first publication arranged by discipline for the first of two or more publications and for, in many cases, the only publication yielded by the dissertations. It is interesting to note that abundance and rapidity are not mutually exclusive, i.e., those individuals publishing more generally publish their first dissertation-based material before the individual publishing a single piece based upon his dissertation.

With the exception of psychology, the time differentials are greater than six months and, in the instance of chemistry, they are nearly eighteen months. In many instances, the first of two or more publications was a progress report while the single publication reported the completed research project. The dissimilar pattern for diffusion of psychology is continued in this instance.

TABLE 18

MEAN YEAR LAG FOR FIRST OF MULTIPLE/SINGLE PUBLICATIONS BASED UPON 312 DISSERTATIONS STUDIED, BY DISCIPLINE

Publications	Mean year lag following acceptance of dissertation			
	Botany	Chemical eng.	Chemistry	Psychology
Single	1.4	1.6	1.0	2.3
First of two or more	.6	.3	- .4[a]	1.8

[a]The lag is a negative one, i.e., the mean occurred before the acceptance of the dissertation.

Sources of dissertation-based publications

An analysis of the publication sources for the 632 dissertation-based materials found in the open literature indicated that 149 journals supplemented by 39 other sources, including irregular serials, monographic series, and monographs, were utilized as outlets. Table 19 illustrates how few journal titles in each discipline carry more than 5 percent of dissertation research reported. Only psychology does not have a journal which reports more than 20 percent of the dissertation research efforts.

Reviewing the journals for each discipline, 36 journals were utilized for 119 botanical publications; 39 journals for 130 chemical engineering publications; 44 journals for 288 chemistry publications; and 47 journals for 95 psychological publications. Psychology, with the fewest publications of the four disciplines, used the largest number of journal outlets. In contrasting chemistry with psychology, it is surprising to note that chemistry had some 200 percent more publications but only 94 percent as many outlets; however, it is probable that the number of dissertations reported in a discipline might double without a corresponding increase of similar magnitude in the number of outlets required.

The percentages for non-journal materials ranged from 3.5 percent in chemistry to 9 percent in botany with the only complete monographs based upon dissertations reported in psychology. From data analyzed on the sources of publications, it would appear likely that anyone with access to an academic library supporting graduate work in the discipline would have ready access to most dissertation-based materials appearing in the open literature.

TABLE 19

JOURNALS GROUPED BY DISCIPLINE WHICH CARRIED MORE THAN 5 PERCENT OF THE DISSERTATION PROJECTS REPORTED

Discipline and journals	Percent of dissertation projects reported	Percent of all materials reported in discipline
Botany		
American Journal of Botany	27.1	17.7
Mycologia	10.2	5.4
Ecology	8.5	3.8
Plant Physiology	8.5	4.6
Journal of Phycology	6.8	3.1
Nature	6.8	3.1
Southwestern Naturalist	6.8	3.1
Canadian Journal of Botany	5.1	3.8
Journal of Cell Biology	5.1	2.3
Journal of General Biology	5.1	2.3
Chemical engineering		
A I C H E Journal	30.5	13.8
Industrial and Engineering Chemistry Fundamentals	18.6	8.5
Journal of Chemical and Engineering Data	10.2	4.6
Industrial and Engineering Chemistry Process, Design, and Development	8.5	3.1
Chemical Engineering Science	5.1	3.1
Journal of Fluid Mechanics	5.1	3.1
Chemistry		
Journal of the American Chemical Society	24.2	19.1
Journal of Chemical Physics	21.0	17.4
Journal of Organic Chemistry	16.9	11.8
Physical Review (All sections)	14.5	9.0
Journal of Physical Chemistry	6.4	4.2
Inorganic Chemistry	5.6	3.4
Psychology		
Journal of Experimental Psychology	9.8	7.4
Psychological Reports	8.4	6.3
Journal of Social Psychology	8.4	6.3
Journal of Verbal Learning and Behavior	7.0	5.3
Journal of Applied Psychology	5.6	4.2

Assimilation of dissertation contents

The dissemination of dissertation research results involves two processes: (1) diffusion and (2) assimilation. The preceding part of the chapter reviewed the results of the investigation involving the diffusion portion of the total process. In the latter part of the chapter, the focus shifts to the assimilation process.

In attempting to assess and characterize assimilation patterns among the four disciplines studied, it was decided to use citations to dissertations as a means for describing assimilation patterns of dissertation contents taken directly from the dissertation itself. In undertaking this portion of the investigation, answers were sought to such questions as the following:

> Are dissertations cited? To what extent? By whom? What is the relationship between the dissertation author cited and the person citing his dissertation?
>
> What is the time lag between the appearance of the dissertation and citations to the dissertation?

In attempting to answer such questions, a two-step process was employed. First the name of each dissertation author included in the study was checked in Science Citation Index to determine if his dissertation had been cited. If the dissertation had been cited, the name(s) of the individual(s) citing the dissertation were included in the questionnaire to the dissertation author. The dissertation author was asked to identify each citing author by one of six pre-selected categories expressing acquaintance-relationship levels. (See Appendix for a copy of the questionnaire.) Omitted from the questionnaire was a seventh category, self-citation, which was added in reporting the results of the investigation.

Inspection of the seven categories reveals that four represent instances in which the citing author was personally acquainted with the dissertation author. In two categories, the citing author is someone with whom the dissertation author is not personally acquainted. In these two categories, the individual has encountered the dissertation through an intermediate person or information source, e.g., colleague. Implications of the citation patterns identified are included in the final chapter within conclusions and suggestions for further study.

Citations to dissertations

Previous studies reviewed in Chapter II indicate that the dissertation as a form of literature constitutes a small percentage of citations taken from published literature; however, there is a total void of available empirical data on the extent to which dissertations within an information pool of dissertations serve as an information source. Table 20 presents data on the percentages of the 441 dissertations studied which were subsequently cited. More than one-half of the dissertations were not cited. This percentage is surprising in view of the fact that 71 percent of the 441 dissertations yielded subsequent publications. The disparity indicates that many dissertation authors

TABLE 20

NUMBER AND PERCENT OF 441 DISSERTATIONS STUDIED WHICH WERE CITED/NOT CITED

Dissertations	Number	Percent
Cited	204	46.3
Not cited	237	53.7

published dissertation-based materials without citing the work upon which it was based, at least in a citation form recognizable to the indexers preparing entries for Science Citation Index. The percentages of authors not citing their own dissertation is more fully covered by data in a table below.

Manipulating the citation data into institutional categories, Table 21 illustrates that the assimilation pattern for dissertations produced at Berkeley is the dissimilar one, with Texas and Penn State exhibiting similar assimilation patterns. In the case of the latter

TABLE 21

NUMBER AND PERCENT OF 441 DISSERTATIONS STUDIED WHICH WERE CITED/NOT CITED, BY INSTITUTION

Dissertations	Institution					
	Berkeley		Penn State		Texas	
	Number	Percent	Number	Percent	Number	Percent
Cited	142	56.6	14	36.8	53	34.9
Not cited	109	43.4	24	63.2	99	65.1

universities, less than one-half of the dissertations were cited either by the author or another individual.

Table 22 presents the same data clumped by discipline. Shifts produced by the manipulation pair psychology and botany on the low end of the citation spectrum and chemical engineering at the high end. While chemical engineering dissertations were well exploited in the diffusion process, so were those of botany. Yet, data in Table 22 pair chemical

TABLE 22

NUMBER AND PERCENT OF 441 DISSERTATIONS STUDIED WHICH WERE CITED/NOT CITED ARRANGED BY DISCIPLINE

Dissertations	Discipline							
	Botany		Chemical eng.		Chemistry		Psychology	
	No.	Percent	No.	Percent	No.	Percent	No.	Percent
Cited	25	37.3	48	71.6	85	52.8	46	31.5
Not cited	42	62.7	19	28.4	76	47.2	100	68.5

engineering and botany assimilation patterns as opposites. Data in the table suggest that diffusion and assimilation patterns may vary greatly, e.g., chemical engineering, or, as in the instance of psychology, remain rather constant. Of the four disciplines, dissertations in two, botany and psychology, have a citation rate of one in three.

Variations within disciplines are less pronounced than those among institutions, although exceptions do occur, e.g., one-third of the dissertations in chemistry at Berkeley were not cited while some 48 percent of the chemistry dissertations at Texas were uncited. An even more extreme variation was noted in the instance of dissertations in chemical engineering at Berkeley and Texas. While only some 10 percent of the former institution's dissertations in chemical engineering were uncited, some 47 percent of the Texas dissertations were uncited.

Authors who cite dissertations

The focus of this section is "Who cites dissertations?" To gather data to answer this question, it was necessary to construct

categories into which persons citing dissertations could be fitted in order to group the data in some logical manner for analysis. As described above, each dissertation author placed each individual citing his dissertation into one of six categories. Table 23 presents data summarizing the responses supplemented with self-citation data derived directly from Science Citation Index. In clumping the data for Table 23, variations within institution and discipline are more readily apparent as the focus shifts to each in turn in Tables 24 and 25.

Data reveal that dissertation authors had cited their own dissertations almost more than any other single category of individuals. The number of self-citations is an indication of the number of individual authors who had published dissertation-based materials, 312 individuals, but failed to cite the dissertation upon which the publication was based.[7] Due to multiple self-citations, the actual number of authors not citing their own dissertations is somewhat higher than it would appear to be based upon data in Table 23. (See Table 26 for additional data on self-citations.) Somewhat surprising is the low percentage of citations, 10.5 percent, by individuals most thoroughly acquainted with the dissertation, the chairman and committee members. Equally surprising is the large percentage of citations by individuals known to the dissertation author, including self-citations, represented by the first five categories in

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[7]As mentioned in the introductory remarks to this section, the author may have acknowledged the dissertation but not in a conventional footnote, which would have been indexed in Science Citation Index. Often the citation statement was included in the text portion of the publication.

For the percentage of authors publishing dissertation-based materials in advance of the dissertation completion, citations to the dissertation became problematical.

TABLE 23

NUMBER AND PERCENT OF 457 CITATIONS CATEGORIZED BY ACQUAINTANCE-RELATIONSHIP LEVELS BETWEEN CITING AUTHOR AND DISSERTATION AUTHOR FOR 204 DISSERTATIONS[a]

Relationship of citing author to cited dissertation author[b]	Number	Percent[d]
Self[c]	101	22.1
Former doctoral student colleague	52	11.4
Chairman or dissertation committee member or member of the faculty at the university from which the Ph.D. was granted	48	10.5
Past or present work colleague at time of citation	40	8.8
Personal acquaintance	41	9.0
Recognize name but not personally acquainted	70	15.3
Not known to the dissertation author	105	23.0

[a]Of the 441 dissertations studied, 237 were uncited.

[b]As the categories are not mutually exclusive, the dissertation author was asked to note the first applicable one in descending order.

[c]A self-citation.

[d]Column does not total 100 percent due to rounding.

Table 23. It is difficult to accept that nearly two-thirds of all individuals currently interested in the topic of the dissertation are known to the dissertation author.

Turning to a presentation of data clumped by institution, citation patterns fluctuate among institutions; however, the patterns do not

differ appreciably from the pattern presented in Table 23, in which the data for all citations were collectively displayed. The percentages in the last category of Table 24, in which the data are arranged by institutional source of the doctorate, provide the basis for inquiring whether the standing of the institution is a factor which may affect citation patterns to dissertations produced within the institution.

Table 25 yields interesting insights into patterns by discipline. The division of data by discipline presents the first occasion in which the category "not known to dissertation author" yields a percent higher than 30. In this instance, chemistry dissertation authors indicate that nearly one-third of those individuals who had cited their dissertation were unknown to the dissertation authors. In fields as large and as diffuse as the four studied, it is surprising that the percentage of citing authors unknown to the dissertation author is not greater in every instance; yet, consider botany in which the percent of unknown individuals is 5.6 or even chemical engineering in which the figure is 14.5

While outside of the scope of this investigation, the disparity between citations to the dissertation and citations to the dissertation-based publications could not be overlooked. The incongruity is the basis for a recommendation for further inquiry contained in the next chapter.

As previously noted, psychology manifests an unique pattern among the four disciplines studied. Table 25 presents data revealing another unique pattern for psychology, a high percentage of citations by chairmen, committee members, and faculty at the institution from which the doctorate was received. The rate ranges from two to seven times as great for psychology as for the other three disciplines.

TABLE 24

NUMBER AND PERCENT OF 457 CITATIONS CATEGORIZED BY ACQUAINTANCE-RELATIONSHIP LEVELS BETWEEN CITING AUTHOR AND DISSERTATION AUTHOR FOR 204 DISSERTATIONS, BY INSTITUTIONAL SOURCE OF THE DOCTORATE[a]

Relationship of citing author to cited dissertation author[b]	Institution					
	Berkeley		Penn State		Texas	
	Number	Percent	Number	Percent	Number	Percent
Self[c]	69	19.4	7	38.9	25	29.8
Former doctoral student colleague	33	9.3	1	5.6	18	21.4
Chairman or dissertation committee member or member of the faculty at the university from which the Ph.D. was received	38	10.7	1	5.6	9	10.7
Past or present work colleague at time of citation	37	10.4	2	11.1	1	1.2
Personal acquaintance	35	9.8	4	22.2	6	7.1
Recognize name but not personally acquainted	52	14.6	3	16.7	14	16.7
Not known to the author	91	25.6	-	--	11	13.1

[a]Of the 441 dissertations studied only 204 were cited.

[b]As the categories are not mutually exclusive, the dissertation author was asked to note the first applicable one in descending order.

[c]Self-citation.

[d]Column may not total 100 percent do to rounding.

Data in Tables 24 and 25 were utilized to produce mean citation rates of dissertations by institution and discipline. Table 26 illustrates

TABLE 25

NUMBER AND PERCENT OF 457 CITATIONS CATEGORIZED BY ACQUAINTANCE-RELATIONSHIP LEVELS BETWEEN CITING AUTHOR AND DISSERTATION AUTHOR FOR 204 DISSERTATIONS STUDIED, ARRANGED BY DISCIPLINE[a]

Relationship of citing author to cited dissertation author[b]	Discipline							
	Botany		Chemical eng.		Chemistry		Psychology	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Self[c]	17	32.1	43	39.1	28	12.4	13	18.8
Former doctoral student colleague	8	15.1	17	15.4	20	8.9	7	10.1
Chairman or dissertation committee member or member of the faculty at the university from which the Ph.D. was received	3	5.7	4	3.6	23	10.2	18	26.1
Past or present work colleague at time of citation	-	—	7	6.4	26	11.6	7	10.1
Personal acquaintance	11	20.8	6	5.4	20	8.9	4	5.8
Recognize name but not personally acquainted	11	20.8	17	15.4	36	16.0	6	8.7
Not known to dissertation author	3	5.7	16	14.5	72	32.0	14	20.3

[a]Of the 441 dissertations studied, 237 were uncited.

[b]As the categories are not mutually exclusive, the dissertation author was asked to note the first applicable one in descending order.

[c]Self-citation. [d]Percentage column may not total 100 percent due to rounding.

that mean rates among institutions vary only slightly. From the data presented, it is clear that the dissertations studied did not attract attention to any great degree. In removing self-citations, two of the three means plunge to a fractional number of citations per dissertation.

TABLE 26

MEAN CITATION RATES FOR DISSERTATIONS STUDIED, BY INSTITUTION

	Mean number of citations
Berkeley	
All dissertations	1.4
Only dissertations cited	2.5
Only dissertations cited with self-citations removed	1.1
Penn State	
All dissertations	.5
Only dissertations cited	1.3
Only dissertations cited with self-citations removed	.3
Texas	
All dissertations	.6
Only dissertations cited	1.6
Only dissertations cited with self-citations removed	.4

Before presenting Table 27 showing the data clumped by discipline, statistics about the range of citations encountered are offered. Of the 204 dissertations cited, 2 were cited 5 times; 5 were cited 6 times; 2 were cited 7 times; 2 were cited nine times; 1 was cited 10 times; and in chemistry, 1 was cited 11 times. These same 13 dissertations represent 26.8 percent of all citations investigated excluding self-citations. Were these same dissertations removed from the study, the mean citation rates would plunge even lower. Too, it is of interest to note that the most heavily cited dissertation had had no publications based upon it.

Turning toward mean citation rates by discipline, Table 27 presents data illustrating the similarity of patterns among disciplines. Only chemistry and chemical engineering manage to maintain a mean of 1.0 with self-citations removed, reflecting the large percentage of

TABLE 27

MEAN CITATION RATES FOR DISSERTATIONS STUDIED, BY DISCIPLINE

	Mean number of citations
Botany	
All dissertations	.8
Only dissertations cited	2.1
Only dissertations cited with self-citations removed	.5
Chemical engineering	
All dissertations	1.6
Only dissertations cited	2.3
Only dissertations cited with self-citations removed	1.0
Chemistry	
All dissertations	1.4
Only dissertations cited	2.6
Only dissertations cited with self-citations removed	1.3
Psychology	
All dissertations	.5
Only dissertations cited	1.5
Only dissertations cited with self-citations removed	.3

dissertations not cited by anyone other than the author. If the data are typical of dissertations in the disciplines studied, the data present a stark picture of how little the likelihood is that a dissertation will be cited. As characterized by the data in Table 28, statistics on time lags, the average "life" of a dissertation in the fields studied is relatively short. While some of the dissertations studied will be

cited in the future, the active "citation life" for most of those studied is ended; therefore, it seems prudent to observe that the number of citations per dissertation studied suggest that the contents of dissertations have limited exposure, limited to a great extent to individuals acquainted with the dissertation author.

Citation lag

In assessing how quickly contents of dissertations become diffused from the original format, the application of citation time lags provides insight into the process. Data extracted from citations suggest that the process takes place over a short duration of time, peaking in the second year for three of the four disciplines studied. Table 28 and Figure 3 portray the citation lags by discipline.

The means for all four disciplines vary only .3 years, suggesting that dissertations have a similar citation life. Further analysis by institution and by sub-discipline yields few major variations, most of which are the result of many citations to a few dissertations or self-citations. Citation lag is the only major area of the investigation in which substantial variations by discipline were not encountered. From these data, the conclusion may be drawn that the useful life of dissertations in the four disciplines is relatively short. While many factors may account for this phenomenon, it would seem important that results of research contained therein ought to be disseminated quickly.

"Lost dissertations"

In concluding the results of the data analysis, a portion of the dissertations studied were labeled "lost dissertations." Such disser-

TABLE 28

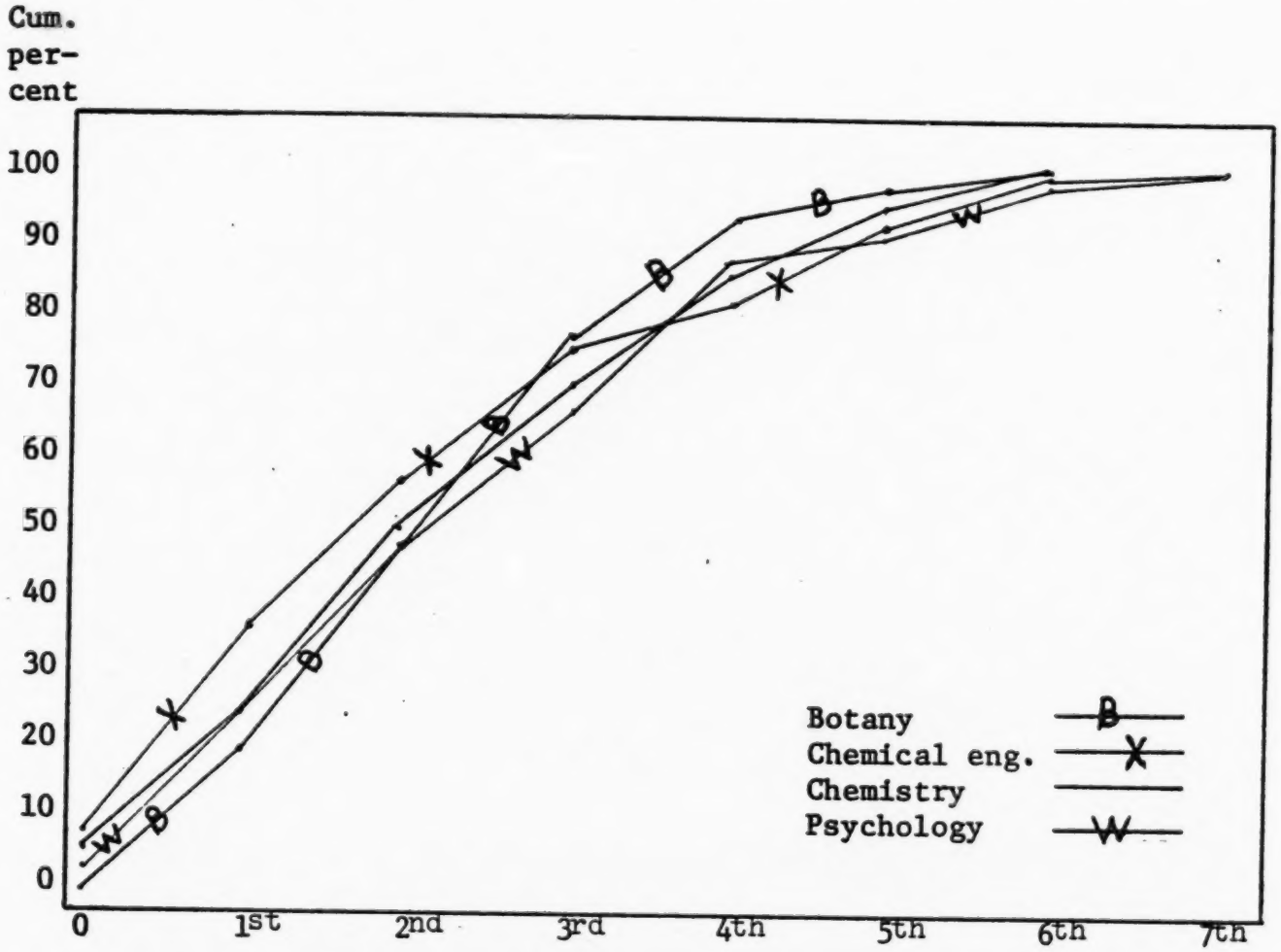
MEAN CITATION LAGS TO DISSERTATIONS STUDIED, BY DISCIPLINE

Citation lag to dissertation by year following acceptance of dissertation	Discipline											
	Botany			Chemical eng.			Chemistry			Psychology		
	No.	Percent	Cum. percent	No.	Percent	Cum. percent	No.	Percent	Cum. percent	No.	Percent	Cum. percent [a]
0	-	--	--	8	7.3	7.3	13	5.8	5.8	2	2.9	2.9
1	10	18.9	18.9	30	27.2	34.5	36	16.0	21.8	13	18.8	21.7
2	15	28.3	47.2	23	20.9	55.4	61	27.1	48.9	18	26.1	47.8
3	16	30.2	77.4	21	19.1	74.5	43	19.1	68.0	12	17.4	65.2
4	9	17.0	94.4	8	7.3	81.8	37	16.4	84.4	15	21.7	86.9
5	2	3.8	98.2	12	10.9	92.7	24	10.7	95.1	3	4.3	91.2
6	1	1.8	100.0	7	6.4	99.1	11	4.9	100.0	5	7.2	98.4
7				1	.9	100.0				1	1.4	99.8

[a]Column does not total 100 percent due to rounding.

FIGURE 3

CUMULATIVE PERCENTAGES OF CITATIONS TO DISSERTATIONS, BY DISCIPLINE



Citation lag by year following acceptance of dissertation

tations have neither served as information sources for materials published in the open literature nor been the object of citations contained in the literature indexed by Science Citation Index. Table 29 groups these dissertations by discipline and by institutional source of the doctorate. Percentages as high as forty and fifty observed in the table, for psychology and Penn State respectively, ought to give rise to concern if the underlying assumption of this investigatin is true, i.e., research is not complete until the research results are disseminated.

TABLE 29

DISSERTATIONS WHICH HAVE NOT SERVED AS INFORMATION SOURCES FOR OTHER PUBLICATIONS OR BEEN CITED BY OTHER AUTHORS IN MATERIALS INDEXED IN SCIENCE CITATION INDEX

Category	Number	Percent of all dissertations studied in each respective category
Discipline		
Botany	6	9
Chemical engineering	8	12
Chemistry	24	15
Psychology	58	40
Institution		
Berkeley	34	14
Penn State	19	50
Texas	43	28

CHAPTER V

SUMMARY, CONCLUSIONS, AND SUGGESTIONS FOR FURTHER STUDY

Summary

The objective of this investigation was to assess the extent to which the Ph.D. dissertation serves as an information source. To achieve this objective, data were gathered to describe two facets of the dissemination process involving research results contained in the dissertation: (1) dissertation-based publications were reviewed to map patterns of diffusion through open literature and (2) authors citing dissertations were identified and the citations analyzed to map patterns of assimilation of dissertation contents from the original format.

The focus of the investigation was 441 dissertations in botany, chemical engineering, chemistry, and psychology produced at the University of California, Berkeley, Pennsylvania State University, and The University of Texas at Austin during the period 1963 to 1967. The research design included the choice of disciplines and universities in order to determine if diffusion and assimilation patterns differ by discipline and/or institution.

The underlying assumption upon which the investigation was based is that the dissertation is a vehicle for the dissemination of results of research undertaken during candidacy for the doctorate. To substantiate the assumption, a literature review was completed.

Recapitulating some of the information derived from the review, the Doctor of Philosophy degree remains, in spite of criticisms (some deserved) and suggestions for change, virtually unaltered since its inception in this country in 1861. Contemporary statements extracted from university catalogs underline the research nature of the degree.

The role of the dissertation was identified through the same procedure. Perusal of university catalogs and bulletins leaves little doubt about the stated intent of what the dissertation should be. As a means for dissemination of research results, the dissertation serves an integral function in the research process. The vital function of dissemination was highlighted in the reports of two prestigious national committees which concluded that research is not complete until results are made available.

In view of the vital role that the dissertation performs, it is surprising that an almost total void of published empirical data about role fulfillment exists. Apart from an investigation reported by McPhie, the dissertation has not served as the focus for investigation; however, a primitive mosaic might be formed by gathering data about dissertations from studies whose focus included dissertations as one facet of a larger study, e.g., Fussler, McAnally, Kanasy, et al.

Unfortunately none of the studies reviewed, including McPhie's study, focused upon the dissertation as an information source. In designing this exploratory study to gather data about the dissertation, it was decided to focus upon the portion of the dissemination process involving formal communications, i.e., published materials. In selecting tools for the investigation, a portion of the literature review centered

upon citations and citation indexing to determine usage of the two in previous investigations. Of special interest were comments and cautions one should recognize before utilizing citations and citation indexing in research endeavors. The use of citations in research in communication encompasses more than forty years. Several intensive literature inquiries have been based upon citations. While citations do have limitations in research use—an excellent summary of such limitations is offered by May; the citation has served remarkably well in defining patterns of information flow.

Data gathered from dissertation authors and Science Citation Index were analyzed to map diffusion and assimilation patterns. The analysis revealed that a single pattern does not exist. Rather, there are variations by discipline, within disciplines, and among the three universities.

Nearly one-third of all dissertations studied were not exploited to produce published materials. The percentages varied by discipline, ranging from 11.9 percent in botany to 51.3 percent in psychology. While variations were noted among institutions, the variations were less extreme than those among disciplines. Too, variations among sub-disciplines were found to be of a less extreme range than among disciplines.

Authorship characteristics of dissertation-based materials exhibited two distinct patterns: (1) single authorship for publications in botany and psychology and (2) multiple authorship in chemistry and chemical engineering. Forty percent of lead authors of dissertation-based materials in chemistry were not the dissertation author upon

whose work the publication was based; in psychology, only 5 percent of the lead authors were not the dissertation author.

The quantities of materials published based upon the dissertation ranged from zero to eight with a mean of 2.03 articles for dissertations yielding publications and a mean of 1.43 articles for all 441 dissertations studied. Variations by discipline were not as extreme as those by institution. There was, however, a distinct variation in patterns among disciplines, e.g., 97 percent of psychology publications per dissertation numbered 2 or less while only 64 percent of chemical engineering publications numbered 2 or less.

It was found that nearly one-third of dissertation-based publications have appeared by the time the dissertation is accepted, with some 50 percent of the materials in chemistry falling into this category while only 10 percent do in psychology. In chemical engineering, some 92 percent of all materials have appeared in the second year following acceptance of the dissertation.

Among first dissertation-based publications, there was a similar pattern in appearance among publications in botany, chemical engineering, and chemistry; however, psychology exhibited a dissimilar pattern, a pattern with a lag nearly two years greater than chemistry.

Sources of dissertation-based materials for the four science disciplines were almost entirely journals, ranging from 96.5 percent in chemistry to 91 percent in botany. All of the journal articles were contained in 149 journals. Psychology, with the fewest publications, had the largest number of journal outlets. Conversely, chemistry, with 200 percent more articles than psychology, had 6 percent fewer journal

outlets than did psychology. Data show that few journals in each discipline report more than 5 percent of the research results. Three disciplines had a single journal reporting more than 20 percent of the research projects while psychology had no journal reporting more than 10 percent.

Assimilation patterns differed by discipline and, to a lesser extent, by institution. It was found that some 53 percent of the dissertations studied had not been cited, even if the dissertation had served as an information source for published materials. Psychology and chemical engineering were paired with low citation rates.

Some 22 percent of the citations were self-citations, with rates ranging as high as 39 percent in chemical engineering to a low of 18 percent in psychology. A surprising aspect of the analysis of citations indicated that nearly two-thirds of the citations to dissertations are made by persons known to the dissertation author. (This percentage includes self-citations.) Except in psychology, a very low percentage of citations are by chairman, committee members, and faculty of the institution from which the Ph.D. was granted. Only chemistry surpasses a 30 percent level of citations by individuals with whom the dissertation author is not acquainted.

The mean number of citations to dissertations ranged from 1.3 to 2.5 when the data are grouped by institution and 1.5 to 2.6 when the same data are grouped by discipline. Coupled to the time lag data presented, which suggests that the mean for all dissertations studied is some 2.7 years, these citation data suggest a short, limited life for the dissertation.

The concluding section of the analysis supplied data about those dissertations which appear to be "lost." These dissertations were not exploited for publications or cited in serial literature indexed in Science Citation Index. In the instance of psychology, the figure was 40 percent compared with 9 percent for botany; in the instance of Penn State, 50 percent, compared with 14 percent for Berkeley and 28 percent for Texas.

Conclusions

It is disturbing that so much energy and so many resources, both human and monetary, have been expended to develop dissertation research for which a very large percentage of the results have not been disseminated. While the research projects undertaken to partially fulfill requirements for the doctorate are themselves completed, from a larger viewpoint, the research process is incomplete in that the results are not used or not made readily accessible to potentially interested researchers. It seems unlikely that of the dissertations studied in psychology, for example, 40 percent did not contain material acceptable to and sought by some journal(s) or material of interest to other researchers and practitioners.

The question then arises, "Why are there so many 'lost dissertations'?" In view of the energy expended, the resources invested, the supervision under which each dissertation author worked, the refereeing process which imposed criteria other than the author's own on all phases of the research project, why do not more of dissertation-research results find their way into use? To this investigator, there appear to be two principal categories into which most of the causes might be placed:

(1) immediate physical access to most dissertations is relatively unavailable to potential users and (2) many dissertation authors do not publish the contents (or a portion) of the completed dissertation in the open literature.

Within recent years, improved bibliographic access to dissertations has been effected by the expanded coverage of Dissertation Abstracts International, to the present day in which virtually all dissertations produced in this country are reported. Accompanying the improved bibliographic access has been the expanded access to copies of dissertations instituted through an agreement between University Microfilms, Incorporated and cooperating graduate schools throughout the country, insuring that a copy of each dissertation accepted will be deposited with University Microfilms. From this deposit copy, University Microfilms can supply upon demand either a microfilm or xerographic copy of the original dissertation.

In spite of improved bibliographic access and a known source of supply, acquisition patterns of libraries apparently have changed little with respect to dissertations since the advent of the improved services, i.e., there is no available evidence to suggest that libraries acquire in substantially greater numbers dissertations now than before the advent of the improved services. For this reason, physical access to dissertations remains, in most instances, one of delay rather than immediacy.

Research suggests that potentially useful sources are often ignored by the researcher in favor of those materials to which he has immediate spatial and/or temporal access. Such an attitude is captured in the observation repeated in several variations by students, faculty,

and researchers encountered in this investigation, "The last source of information that I would consult for material is Dissertation Abstracts. Likely any material identified would not be held by our library and, usually, the costs, nuisance and time, to obtain the dissertation are too great. Therefore, Dissertation Abstracts and, consequently, dissertations will remain of little value to me as sources of information."

From data collected in this study, there is evidence that the expenditure of effort and money in establishing the national system of access to dissertations may not have substantially improved a researcher's ability to capitalize upon information contained in dissertations, for improved bibliographic access and a centralized source of supply appear to be only the initial steps in a process that must also include dispersion of dissertation copies to collections of materials to which the possible user has relatively immediate access, spatially and temporally.

In view of the carefully supervised and refereed conditions under which dissertations are produced and the similarities between dissertations and other scholarly monographs, why are dissertations not more widely distributed? What are some plausible explanations or causes of the limited distribution of most dissertations?

While observers believe that the present system is an improvement over the former one, possible, yet unidentified dysfunctional consequences of consolidating former sources of supply, i.e., individual graduate schools and libraries, into a single national depository at University Microfilms may account for a portion of the causes of limited distribution of dissertations.

Monographs published by commercial publishers and by non-profit

organizations are normally available from the publisher, and in addition, a host of commercial wholesalers and jobbers. Dissertations, at least recent ones (recall that one-half of the dissertations produced in this country have been written in the last decade), are primarily available only from University Microfilms.[1] In spite of the uniquely identified source of supply for dissertations, the necessity for an additional routine to handle dissertation orders may offset the apparent advantage of a known source of supply.

Too, the passive mode[2] in which University Microfilms sells dissertations may negatively affect distribution. Unlike the traditional publisher who advertises new titles through various media and other promotional devices, University Microfilms as a publisher simply relies upon Dissertation Abstracts International as a means to sell copies of dissertations on deposit.

Another cause of limited distribution of dissertations to libraries may be related in some manner to the varying availability of prepared cataloging data for dissertations. The Library of Congress has undertaken a massive program to acquire a large percentage of monographs of research importance wherever published in the world; yet, dissertations produced in the United States are acquired normally by the Library of Congress as a byproduct of the copyright process for those dissertations copyrighted, an option left to the decision of the

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[1]Few library wholesalers and jobbers will supply copies of dissertations.

[2]Since dissertations are normally produced only upon demand rather than in anticipation of demand as are most commercially produced monographs, the process is characterized as operating in the "passive mode."

dissertation author. In the course of processing materials for the collection at the Library of Congress, bibliographic data for materials added to the collection are produced in the form of cataloging copy, which is subsequently available to libraries throughout the country through the National Union Catalog, Library of Congress catalog card sets, and MARC Tapes. For most dissertations, however, such cataloging data are not available, forcing each library to prepare records locally, an expensive, time-consuming process. The absence of readily available, full cataloging data for most dissertations may inhibit the distribution of dissertations among libraries. Too, libraries utilizing Library of Congress proof slips in the selection process may be unaware of the percentage of dissertations produced in this country annually not represented by proof slips.

The very acquisitions procedures of many libraries may affect the dissertation distribution process. In recent years, several libraries have undertaken to collect materials through procedures variously described as "approval plans,"[3] "gathering plans,"[4] and "standing order plans."[5] To the investigator's knowledge, few, if any, of the plans cited include provision for the acquisition of dissertations. On the other hand, in the course of participating in such plans, libraries may automatically

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[3]A procedure in which the library may return materials shipped automatically to the library, usually on the basis of an interest profile, after inspection if the material is deemed not suitable for inclusion in the collection.

[4]A procedure designed to acquire in an exhaustive manner all materials deemed relevant to the needs of the library's user population.

[5]The prior selection of materials on the basis of the publishing source.

acquire dissertation-based materials, as most plans may be characterized by the term "inclusive" rather than "exclusive."

Another question then arises. If the acquisitions process in libraries under such plans includes dissertation-based publications as worthwhile additions to the collection, why did not the library seek to acquire the original dissertation, which was likely available months, or even years, before the appearance of the newly released form? Factors cited above--source of supply, availability of cataloging data, and programs offered by jobbers--may affect the distribution of dissertations; however, in each instance the effects appear to be byproducts of a process rather than the result of a conscious decision not to acquire dissertations. In seeking answers to the question of why libraries do not choose to acquire dissertations as they are produced, attention must be focused upon a decision, at some point in time, consciously or unconsciously made to exclude such materials.

Possibly the greatest deterrent to the acquisition of dissertations in libraries is the prevailing assumption that most dissertations find their way into print in forms normally acquired automatically by most academic and research libraries, for example, in commercially-published monographs and serials. In reflecting upon why libraries surveyed by the Center for Research Libraries[6] reported that they purchased almost no dissertations in the four disciplines studied in this paper, an observer conjectured that this must indicate that most dissertations in these fields are fairly quickly published in the form of journal articles and, assuming this, libraries find it simpler and cheaper to

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[6]Center for Research Libraries, op.cit.

rely upon access to the information in this form. Apparently such a belief is widespread among librarians; however, expression of the supposition is not limited to librarians, as comments from dissertation authors and supervisors encountered during this investigation attest. For example, one dissertation author observed in completing his questionnaire for the study reported here that every reliable piece of information in a chemistry thesis appears in journals. Considering that some 23 percent of the chemistry dissertations studied did not yield subsequent publications and some 51 percent of the psychology dissertations studied failed to yield a publication, it would seem that the assumption is substantially inaccurate.

For those dissertations which do serve as sources for subsequent publications, substantial parts of the dissertation are typically excluded unless the whole dissertation is published. Consider how infrequently the literature review portion of the dissertation is published. In view of the ever-increasing number of review publications, especially annual reviews, it is surprising that the literature reviews from dissertations are not subsequently published. For this valuable portion of the dissertation, the original study is normally the sole source from which an interested reader may obtain an up-dated and thorough review of literature pertaining to the topic.

A more subtle reason why libraries do not acquire dissertations may be the manner in which the dissertation work is perceived. To many librarians, the dissertation is a form of literature that should be set apart. Whether this is due to format, or connotes that librarians see dissertations as less well validated than materials reviewed by referees

preparatory to publication or as the product of a training process rather than the product of research outside academe, such opinions must have ramifications extending into many facets of the process of communicating dissertation research results.

In general, it seems that dissertation authors have little control over what happens to the original dissertation and, if improvements in the dissemination system are needed, other individuals are necessarily in a better position to implement change in the system.

Conversely, dissertation authors are in a strategic position to effect changes in many areas encompassed within the second primary category of causes why dissertation research results do not find their way into use, the author's failure to publish material based upon the dissertation.

As noted in the previous chapter, one of the principal causes of dissertation authors not publishing materials from their dissertations is a lack of interest in the subject upon the author's part. While a myriad of specific reasons for a lack of interest surely exist, one might be the very process which produces the doctorate the the dissertation. To many candidates, the doctoral program is so intense that, once the dissertation is completed, the paper is forever set aside, figuratively and/or literally.

For many, the research project and the completion of the dissertation are simply steps which must be taken before obtaining the doctorate. For example, many dissertation authors opt into ongoing research of a faculty member or a department. For a portion of these dissertation authors, the topic to be investigated is not one of primary interest; rather, it may be the least onerous of those available.

Conversely, there are dissertation authors for whom the research for their dissertation is of great interest, yet that interest is replaced by others following completion of the doctorate. While many causes effect changes of interest, one of the more common is the demands of the position in which the author finds himself following completion of the degree. For example, the rewards for those within positions in industry may have entirely different foundations than those employed in academic institutions.

Differences between those who were interested in publishing and succeeded in doing so and those who were interested but failed to do so are not readily apparent. Some of the major dissimilarities among fields studied may eventually be traced to authorship patterns, i.e., single vs. multiple authorship. The impetus that the student derives from interest of the faculty member cooperatively working toward a common goal of a publication must exert a positive force upon the dissertation author preparing the material. The very presence of large numbers of single-authorship publications indicates that either authorship pattern may produce materials for publication; however, the proportion of dissertation-based materials produced within all fields might be higher (in some fields substantially higher) were the percentage of shared-authorship publications increased.

Causes of non-publication seem to lie predominantly with the dissertation author. For this reason, the potential of shared authorship offers added insights to the novice author in the form of selection of outlets and presentation style. Too, by lending authority through the use of the supervisor's name, multiple authorship allows the author to

overcome the hyper-critical self-judgement derived in defending his dissertation as it develops and the inertia to publish.

As few, if any, data are available on rejection rates of dissertation-based materials by potential publishers, the impact of rejection of offered materials is difficult to assess. However, if the aggregated data for rejection of all submitted materials do not differ radically from those pertaining only to dissertation-based materials, the impact of rejection is slight, for there seem to be outlets sufficient to offer a vehicle for most manuscripts.

While it would appear to be in the interest of all departments and schools to insure that dissertations produced under their auspices were brought to the attention of all interested parties, some departments and schools appear to have established a policy, tradition, or high value upon the publication of dissertation contents while others show little evidence of interest. Some departments and schools practically insure publication by encouraging the students to produce papers in a form amenable to publication with few, if any, changes required. In some instances, each chapter is a discrete unit, suitable for immediate publication; in other cases, the body of the paper is presented in journal-article format with data which normally would be integrated into the body of the paper set apart in appendices, a process which facilitates the acceptance of material for publication with a minimum of alteration required.

For an undefined percentage of dissertations in a rapidly advancing field, for example, the value of the content may be quite transitory and may not be amenable to further exploitation. For still another segment of dissertations, the quality of work is questionable

and deserves no wide audience. However, comments offered during this investigation strongly suggest that the last two reasons include only a miniscule percentage of all dissertations studied; therefore, it seems reasonable to conclude that most dissertations recently produced in the fields studied deserve some form of exploitation through subsequent publication in the open literature.

Some data derived from the investigation illustrate the disparity between the diffusion of dissertation contents in the original format and in subsequent publications. Fourteen dissertations studied in chemical engineering produced in 1963-64 yielded a total of 26 citations by 1970 in publications indexed in Science Citation Index. The dissertation-based materials published in the open literature for these 26 dissertations (approximately 2 articles per dissertation) yielded 219 citations in the same period. The correlation between citations to dissertations and citations to dissertation-based materials derived from the same dissertations is .04. The citation figures suggest two separate implications: (1) citations to dissertations may not accurately reflect potential interest in the contents and (2) citations to dissertation-based materials rather than to the original dissertation reflects, to this investigator, the relative inaccessibility of dissertations.

Implications of the above conclusions and speculations have possible wide-ranging repercussions for many segments of the graduate education community within which the dissertation research is completed. Although benefits which might accrue to each member of the community (dissertation author, supervisor, sponsoring department, and university) as well as to the discipline within which the work is completed are

difficult to assess, all would profit from a reevaluation of the emphasis placed upon disseminating results obtained through one of the most expensive information-production processes known, i.e., research.

Possible steps to induce exploitation of dissertations might include financial and/or other forms of aid to the dissertation author in the production of materials for publication; requiring the production of accepted publications based upon the dissertation as an additional requirement for the doctorate; reexamination of the professional ethic, if such exists, which discourages multiple authorship of dissertation-based publications or other factors which preclude more extensive use of the second author, whether lead or otherwise; and changes in the dissertation itself which may encourage subsequent publication, for example, length, style, or topic.

The potential benefits likely to accrue to interested researchers and practitioners ought not to be underestimated. Any actions taken by the information-producing community will likely have profound effects upon the information-consuming community. Since the two communities are often indistinguishable, what serves one often serves the other in their symbiotic relationship.

If implications enumerated above seem to suggest pervasive changes for the graduate education community, implications for libraries and librarians are equally, if not more, pervasive. Data accrued in this investigation suggest that librarians must reevaluate the assumptions upon which the present dissertation-acquisition practices are based. For example, the assumption that most dissertations are subsequently published seems fallacious. Should the range of extremes for all disciplines be even greater than those of the four disciplines studied, then the

assumption is even more erroneous than the present study suggests.

The dysfunctional consequences of delayed access to dissertations and their subsequent usage by researchers and practitioners should be considered a pressing issue among librarians.

In view of the possible inhibiting effects which present practices may have upon dissertation dissemination and ultimate use, librarians should re-examine the present distribution system for dissertations, the varying availability of cataloging data, the exclusion of dissertations from jobber-centered acquisition programs, and the effect that format may have upon the dissertation-acquisition practices of libraries. While conscious decisions to exclude dissertations may not have been made, the cumulative effects of the above factors, coupled to others not yet identified, appear to produce nearly an identical result. A primary question which librarians should ask is this: If libraries acquire dissertations in the same proportions as they do other scholarly monographs (i.e., in proportions to the totals produced), would not the usage of dissertations change perceptibly?

Recommendations for further study

Has the nature of the dissertation in some fields changed through time? Has the way dissertations are viewed in some fields changed? Have such changes affected probability of subsequent publication of dissertation contents? These questions suggest a study of dissertations in different fields over a long period of time.

In view of the differences encountered in this investigation, the study ought to be extended into other fields and other institutions in order to derive generalizable observations about dissertations as

information sources. Particularly pressing is the inquiry as to whether characteristics of diffusion and assimilation of research results differ between scientific and non-scientific fields.

Do dissertations prepared in formats resembling journal articles or arranged in formats in which each chapter is a discrete entity yield more subsequent publications than dissertations prepared along more classical styles?

Does shared authorship increase the probability of subsequent publication?

What effects might publishing reviews of dissertations alongside other book reviews in traditional book review media have upon the requests for acquisition of dissertations in libraries?

Until studies like the present one are complemented by inquiries into the informal communications process, understanding of dissertation research dissemination will only be partial.

In view of the national expenditure of resources for the production of doctorates, it would seem that dissertations--one of unexploited resources of this nation--are themselves worthy of diverse and concentrated research efforts.

APPENDIX

DISSERTATIONS RESEARCH PROJECT
BOX 8131, UNIVERSITY STATION
AUSTIN, TEXAS 78712

March 13, 1972

As one of 32 Ph.D. recipients in Botany from the University of California, Berkeley in the period 1963-7, we are seeking your aid in securing data about "the Ph.D. dissertation as an information source." This project in cooperation with the Department of Botany, the University of California, Berkeley is a part of the research program of the Graduate School of Library and Information Science of the University of Texas at Austin.

The enclosed questionnaire was designed to gather data about dissemination patterns of the contents of dissertations as this information becomes integrated into the discipline's body of knowledge through various published sources.

To assure anonymity, results of the study will be prepared so that no one individual's identity will be recognizable. Participants in the study will each receive a summary of the data obtained. The brief questionnaire enclosed is the only obtrusive measure used in the study.

For your convenience, a return stamped addressed envelope is provided for the completed questionnaire.

Thank you for your interest and aid in the project.

Sincerely,

Calvin J. Boyer

Enclosures: 2

CJB:mmi

DISSERTATIONS RESEARCH PROJECT
QUESTIONNAIRE

NAME _____ Current address IF DIFFERENT THAN THAT

Date Degree Conferred (Month and Year) _____ LISTED ON COVER LETTER

_____
_____
_____

Have you authored or co-authored any *PUBLISHED* journal articles, abstracts, books, or parts of books, i.e., chapters or sections, which were *based primarily upon your dissertation**? If so, please list citations below. If not, please circle *NONE* and return the questionnaire.

FOR JOURNAL ARTICLES ABSTRACTS (Use back if necessary.)

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
JOURNAL _____
VOLUME _____
PAGES _____
MONTH AND YEAR _____

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
JOURNAL _____
VOLUME _____
PAGES _____
MONTH AND YEAR _____

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
JOURNAL _____
VOLUME _____
PAGES _____
MONTH AND YEAR _____

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
JOURNAL _____
VOLUME _____
PAGES _____
MONTH AND YEAR _____

FOR BOOKS (Use back if necessary.)

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
TITLE _____
YEAR _____

FOR PARTS OF BOOKS (Use back if necessary.)

AUTHOR'S (S') SURNAME AND BOTH INITIALS _____
CHAPTER TITLE _____
EDITOR'S (S') SURNAME _____
TITLE OF BOOK _____
YEAR _____

* The underlined phrase, *based primarily upon your dissertation*, should be interpreted to exclude materials reporting research performed subsequent to the completion of the dissertation. The primary content of the publication should be nearly identical to that of the dissertation. Some eligible materials may have been published prior to the completion of the dissertation.

Page 2- Questionnaire

II. The persons listed below are authors who have cited your dissertation. Following each name are six letters. Each letter is keyed to a category which might describe a relationship between you and the author citing your dissertation. For each name, *CIRCLE* the first letter in the sequence which describes the actual relationship between you and the author named at the time of the citation.

Example

Smith, R.A. 1965 A B C D (E) F

(The dissertation author recognized the name R.R. Smith but he was not personally acquainted with Smith.)

Note: As some of the categories are not mutually exclusive, use the first letter which describes the relationship.

A - Former doctoral student colleague of mine

B - Chairman or dissertation committee member or member of the faculty at the university from which I received the Ph.D.

C - Past or present work colleague at the time of the citation

D - Personal acquaintance

E - Recognize name but not personally acquainted

F - Not known to me

The following individuals have cited your dissertation. Circle the first appropriate letter which describes the actual relationship between you and the person citing your dissertation.

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

A B C D E F

Note: Names were taken from Science Citation Index. Surnames longer than 9 characters have been truncated by a period after the eighth letter of the name.

BIBLIOGRAPHY

Allen, Edward S. "Periodicals for Mathematicians." Science, LXX (December, 1929), 592-94.

American Doctoral Dissertations, 1969-1970. Compiled for the Association of Research Libraries. Ann Arbor, Mich.: University Microfilms, 1971.

Armstrong, Robert Plant. "The Qualities of a Book, The Wants of a Dissertation." Scholarly Publishing: A Journal for Authors and Publishers, III (January, 1972), 99-109.

Barker, Dale Lockard. "Characteristics of Scientific Literature Cited by Chemists of the Soviet Union." Unpublished Ph.D. dissertation, University of Illinois, 1966.

Barr, K. P. "Estimates of the Number of Currently Available Scientific and Technical Periodicals." Journal of Documentation, XXIII (June, 1967), 110-16.

Barzun, Jacques. The American University: How It Runs; Where It Is Going. New York: Harper & Row, 1968.

Bayer, Alan E., and Folger, John. "Some Correlates of a Citation Measure of Productivity in Science." Sociology of Education, XXXIX (Fall, 1966), 381-90.

Berelson, Bernard. Graduate Education in the United States. New York: McGraw-Hill, 1960.

Brace, William. "A Citation Analysis of Dissertations in Library and Information Science (1960-1970) to Identify a Core Literature as It Is Related to the Curriculum" Unpublished Ph.D. dissertation, Case-Western Reserve University, in progress, 1972.

Breneman, David W. The Ph.D. Degree at Berkeley: Interviews, Placement, and Recommendations. Paper P-17. Berkeley, Calif.: Office of the Vice President--Planning and Analysis, University of California, 1971.

Brickman, William W., and Lehrer, Stanley, eds. A Century of Higher Education: Classical Citadel to Collegiate Colossus. New York: Society for the Advancement of Education, 1962.

Brown, Charles Harvey. Scientific Serials: Characteristics and Lists of Most Cited Publications in Mathematics, Physics, Chemistry, Geology, Physiology, Botany, Zoology and Entomology. ACRL Monograph No. 16. Chicago: Association of College and Reference Libraries, 1956.

Bulletin, Courses and Degrees, 1971/72. Stanford, Calif.: Stanford University, 1971.

Bureau of Information Sciences Research. Graduate School of Library Service. Rutgers--The State University. Bibliography of Research Relating to the Communication of Scientific and Technical Information. New Brunswick, N.J.: Rutgers University Press, 1967.

Carmichael, Oliver C. Graduate Education: A Critique and a Program. New York: Harper & Brothers, 1961.

Center for Research Libraries. "An Investigation of a Proposal to Acquire U.S. Doctoral Dissertations at the Center for Research Libraries." Chicago, 1970. Unpublished report.

Clark, Beverly L. "Multiple Authorship Trends in Scientific Papers." Science, CXLVII (May, 1964), 822-24.

Committee on Scientific and Technical Communication. National Academy of Sciences--National Academy of Engineering. Scientific and Technical Communication: A Pressing National Problem and Recommendations for Its Solution. Washington, D.C.: National Academy of Sciences, 1969.

Confrey, Eugene A. "Information Exchange Groups to Be Discontinued." Science, CLIV (November, 1969), 843.

Crane, Diana. Invisible Colleges: Diffusion of Knowledge in Scientific Communities. Chicago: University of Chicago Press, 1972.

Crawford, Susan Y. "Informal Communication Among Scientists in Sleep and Dream Research." Unpublished Ph.D. dissertation, University of Chicago, 1970.

Description of Courses and Academic Programs for Graduate Study 1970. East Lansing, Mich.: Michigan State University, 1970.

Fussler, Herman H. "Characteristics of Research Literature Used by Chemists and Physicists in the United States." Unpublished Ph.D. dissertation, University of Chicago, 1948.

Garfield, Eugene A. "'Science Citation Index'--A New Dimension in Indexing." Science, CXLIV (May, 1964), 649-54.

Garvey, William; Lin, Nan; and Carnot, Nelson. "Some Comparisons of Communication Activities in Physical and Social Sciences." Communication Among Scientists and Engineers. Edited by Carnot E. Nelson and David K. Pollack. Lexington, Mass.: Heath Lexington Books, 1970.

General Announcements for the Academic Year 1971-1972. Houston: William Marsh Rice University, 1971.

General Catalog. Berkeley, Calif.: University of California, Berkeley, 1971.

Glenny, Lyman. "Doctoral Planning for the 1970's." Research Reporter VI, No. 1 (1971), 1-5.

Graduate Catalog. Urbana, Ill.: University of Illinois, Urbana-Champaign, 1969.

Graduate Study in Engineering and Applied Science, 1971-72. New Haven, Conn.: Yale University, 1971.

Grigg, Charles M. Graduate Education. New York: The Center for Applied Research in Education, Inc., 1965.

Gross, P. L. K., and Gross, E. M. "College Libraries and Chemical Education." Science, LXVI (October, 1927), 385-89.

Hansen, Harold P. The Ph.D. Surplus--Realities and Illusions. Washington, D.C.: Council of Graduate Schools in the United States, 1970.

Henkle, Herman H. "Periodical Literature of Biochemistry." MLA Bulletin, XXXVII (December, 1938), 139-47.

Hintz, Carl William. "Internationalism and Scholarship: A Comparative Study of the Research Literature Used by American, British, French, and German Botanists." Unpublished Ph.D. dissertation, University of Chicago, 1952.

Horace H. Rackham School of Graduate Studies, 1970-71. Ann Arbor, Mich.: University of Michigan, 1970.

Intrama, Navanitaya. "Some Characteristics of the Literature of Public Administration." Unpublished Ph.D. dissertation, Indiana University, 1968.

Kanasy, James Emery. "Citation Characteristics and Bibliographic Control of the Literature of Microbiology." Unpublished Ph.D. dissertation, University of Pittsburgh, 1971.

Kaplan, Norman. "The Norms of Citation Behavior: Prolegomena to the Footnote." American Documentation, XVI (July, 1965), 179-84.

Kilgour, Frederick G. "Publication of Scientific Discovery: A Paradox." Proceedings of the 1966 ADI Annual Meeting. Edited by Don V. Black. Woodlands, Calif.: Adrianne Press, 1966.

Koefod, Paul E. The Writing Requirements for Graduate Degrees. Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964.

Lao Sunthara, Maria. "Some Bibliographical Characteristics of Serial Literature in the Field of Geology." Unpublished Ed.D. dissertation, Indiana University, 1956.

Libbey, Miles A., and Zaltman, Gerald. The Role and Distribution of Written Informal Communication in Theoretical High Energy Physics. New York: American Institute of Physics, 1967.

Littleton, Isaac Thomas. "The Bibliographic Organization and Use of the Literature of Agricultural Economics." Unpublished Ph.D. dissertation, University of Illinois, 1968.

McAnally, Arthur M. "Characteristics of Materials Used in Research in United States History." Unpublished Ph.D. dissertation, University of Chicago, 1951.

McPhie, Walter E. "Factors Affecting the Use and Value of Dissertations in Social Studies Education." Unpublished Ph.D. dissertation, Stanford University, 1959.

_____. "Factors Affecting the Value of Dissertations." Social Education, XXIV (December, 1960), 375-77, 85.

Margolis, J. "Citation Indexing and Evaluation of Scientific Papers." Science, CLV (March, 1967), 1215-19.

May, K. O. "Abuses of Citation Indexing." Science, CLVI (May, 1967), 890.

Mellon Institute of Science and Carnegie Institute of Technology, Graduate Studies, 1970-1972. Pittsburgh: Carnegie-Mellon University, 1970.

Menzel, Herbert. "Informal Communication in Science: Its Advantages and Formal Analogues." The Foundations of Access to Knowledge. Edited by Edward B. Montgomery. Syracuse, N.Y.: Syracuse University, 1968.

National Science Board. National Science Foundation. Graduate Education; Parameters for Public Policy. Washington, D.C.: National Science Foundation, 1969.

Nelson, Carnot E., and Pollack, David K., eds. Communication Among Scientists and Engineers. Lexington, Mass.: Lexington Heath Books, 1970.

"1970: A Big Boost in Book Titles . . . as Recorded in PW." Publishers' Weekly, CXCIX (February 8, 1971), 32-3.

1971-1972, The Pennsylvania State University: Graduate Degree Programs. University Park, Penn.: Pennsylvania State University, 1971.

1969 and 1980, Science & Engineering Doctorate Supply & Utilization. NSF 71-20. Washington, D.C.: National Science Foundation, 1971.

Paisley, William J. The Flow of (Behavioral) Science Information; A Review of the Research Literature. Stanford, Calif.: Institute for Communication Research. Stanford University, 1966.

Parker, Edwin B.; Paisley, William J.; and Garrett, Roger. Bibliographic Citations as Unobtrusive Measures of Scientific Communication. Stanford, Calif.: Institute for Communication Research. Stanford University, 1967.

Pasternack, Simon. "Criticism of the Proposed Physics Information Exchange." Physics Today, XIX (June, 1966), 63.

Price, Derek J. de Solla. Little Science, Big Science. New York: Columbia University Press, 1963.

_____. "Networks of Scientific Papers." Science, CIL (July, 1965), 510-15.

_____. Science Since Babylon. New Haven, Conn.: Yale University Press, 1961.

Princeton University, The Graduate School Announcement, 1971-1972. Princeton, N.J.: Official Registrar of Princeton University, 1971.

Prior, Moody E. "The Doctor of Philosophy Degree." Graduate Education Today. Edited by Everett Walters. Washington, D.C.: American Council on Education, 1965.

Record of the University of North Carolina at Chapel Hill, The Graduate School, Announcements for the Session 1971-1972. Chapel Hill, N.C.: University of North Carolina Press, 1971.

Roose, Kenneth D., and Andersen, Charles J. A Rating of Graduate Programs. Washington, D.C.: American Council on Education, 1970.

Rosenbloom, Richard S., and Wolek, Francis W. Technology and Information Transfer: A Survey of Practice in Industrial Organizations. Boston: Division of Research. Graduate School of Business Administration. Harvard University, 1970.

Rudy, Willis. "Higher Education in the United States, 1862-1962." A Century of Higher Education: Classical Citadel to Collegiate Colossus. Edited by William W. Brickman and Stanley Lehrer. New York: Society for the Advancement of Education, 1962.

Schweitzer, George K. The Doctorate: A Handbook. Springfield, Ill.: C. C. Thomas, 1965.

Simonton, Wesley Clark. "Characteristics of the Research Literature of the Fine Arts During the Period 1948-1957." Unpublished Ph.D. dissertation, University of Illinois, 1960.

Spalinger, Donald Lloyd. "The Evaluation of Research Productivity Using Publications and Citations, Applied to University Physics Departments." Unpublished M.B.A. thesis, The University of Texas at Austin, 1971.

Stevens, Norman D. Review of Management Personnel in Libraries: A Theoretical Model for Analysis, by Kenneth Plate. Library Resources and Technical Services, XXXI (Summer, 1971), 419.

U.S. President's Science Advisory Committee. Science, Government, and Information: The Responsibilities of the Technical Community and the Government in the Transfer of Information. Washington, D.C.: Government Printing Office, 1963.

Walters, Everett, ed. Graduate Education Today. Washington, D.C.: American Council on Education, 1965.

_____. "Graduate Education, 1862-1962." A Century of Higher Education: Classical Citadel to Collegiate Colossus. Edited by William W. Brickman and Stanley Lehrer. New York: Society for the Advancement of Education, 1962.

Webster's Third New International Dictionary of the English Language, Unabridged. Springfield, Mass.: G. & C. Merriam & Co., 1961.

Weinstock, Melvin. "Citation Indexes." Encyclopedia of Library and Information Science. Vol. V.

Williams, David C. "Stop the Dissertation!" Educational Leadership, XXVIII (April, 1971), 753-56.

Wolff, Robert P. The Ideal University. Boston: Beacon Press, 1969.

Wolfle, Dael, and Kidd, Charles V. "The Future Market for Ph.D.'s." Science, CLXXIII (August, 1971), 784-93.

Yearbook of Higher Education, 1969. Los Angeles: Academic Media, 1969.

VITA

Calvin James Boyer was born in Charleston, Illinois, on March 4, 1939, the son of Hazel Childress Boyer and Ernest Zimmerman Boyer. After completing his work at Oakland Community Unit High School, Oakland, Illinois, in 1957, he entered Eastern Illinois University, at Charleston, Illinois. He received the degree Bachelor of Science in Education with a major in foreign languages from Eastern Illinois University in May 1962. During the following year, he was employed as a librarian in the Beardstown High School, Beardstown, Illinois. In June, 1963, he entered the Graduate School of Library Science of The University of Texas at Austin. He was awarded the degree of Master of Library Science in August, 1964. During the following five years he was employed by Texas A&M University as acquisitions librarian and by Midwestern University, Wichita Falls, Texas, as Library Director. In 1969 he was awarded a Title II H.E.A. Fellowship to pursue studies leading toward the degree of Doctor of Philosophy in library and information science. Following completion of the degree, he was employed by the Graduate Library School of Indiana University, Bloomington, Indiana. In 1957, he married Roberta Lorraine Davis of Westfield, Illinois. The couple has a daughter, Carmellia, and a son, Jeffrey.

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This dissertation was typed by Ms. Janice Maupin.